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# Some New Gold Dredges in Alaska

By Lewis H. Eddy

The Union Construction Co., of San Francisco, completed four placer gold dredges and had one in course of construction in Alaska in the season of 1912. The completed boats are all equipped with open-link California type buckets. Two (Pasadena and Inmachuck) are driven by Union gasoline engines, two (Ruby and Candle) by Western gas engines, all using California distillate. One is equipped with revolving screen and belt-conveyor tailing stacker; three are equipped with flumes. They are owned and operated as follows:

### Details of Five New Dredges

The dredge of the Pasadena Gold Dredging Co. is of the screen and stacker type; has 3-cu.ft. buckets, digging 20 ft. below the water line; is operated on Budd Creek, Port Clarence mining district. Hugo Johnstone, Pasadena, Calif., is president of the company.

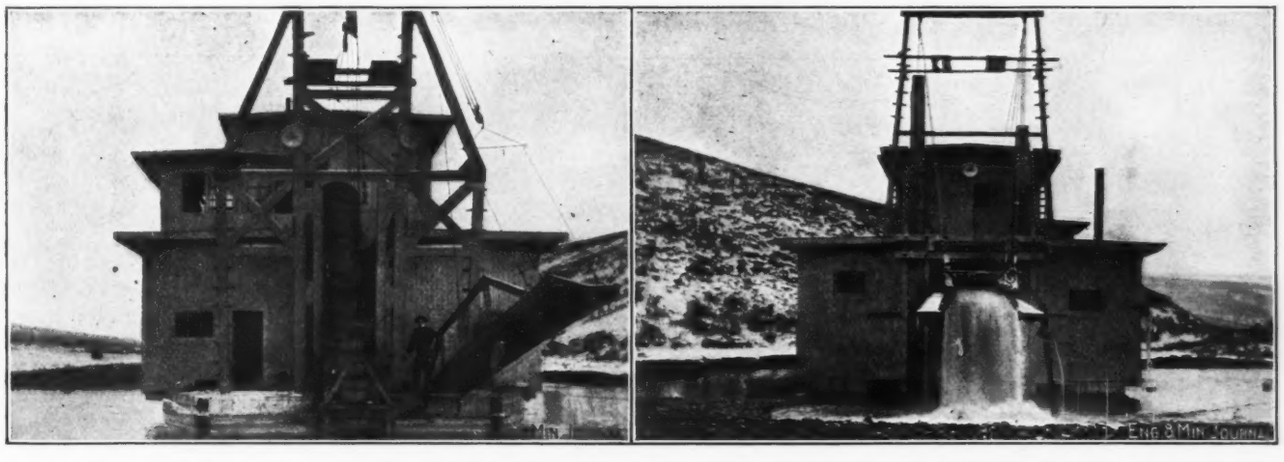
The boat of the Inmachuck Dredging Co. is of the flume type. It is equipped with 3-cu. ft. buckets, digging 18 ft. below the water line and is operated on Inmachuck River, Fairhaven mining district. The president of the company is W. W. Johnson, San Francisco.

The Ruby Dredging Co. dredge, of the flume type, has 2¾-cu.ft. buckets, digging 15 ft. below the water line. It is operated on Casadepoga River, Solomon mining district. T. C. Powell, Nome, Alaska, is manager.

The dredge of the Candle Creek Dredging Co. is of the flume type; equipped with 1¾-cu.ft. buckets and digging 12 ft. below the water line. It is operated on Candle Creek, Arctic Ocean, Candle Creek mining district. E. E. Pierce, of Candle, Alaska, is manager.

The dredge under construction is for the Sewall Dredging & Power Co. It will be equipped with close-connected 3-cu.ft. California-type buckets designed to dig 30 ft. below the water line. It will be electrically driven by a stationary hydro-electric plant, and equipped also with an auxiliary gas engine.

The transportation of dredge machinery and constructed parts from the Alaskan coast to interior points is an interesting feature of Alaska dredge installations. The material is shipped from San Francisco and Seattle by steamer to the port nearest or most conveniently reached by available methods of transportation. The Pasadena dredge machinery was landed at Teller on July 5, and from that point was hauled on a sternwheel steamer, in American River, a distance of 50 miles, the end of steamer navigation. A further water haul of about 25 miles was made with horse scows. The scows, five in number, each loaded with 12 tons, were 60 ft. long, 7 ft. 6 in. wide at bottom, 11 ft. wide at top. The overland haul to the dredge site on Budd Creek was by horse and wagon teams. The dredge was placed in commission on Sept. 4 and operated until Oct. 3. The gravel is small and easy digging. The dredge averaged 1500 cu.yd. of gravel and used 190 gal. of distillate in 24 hours.



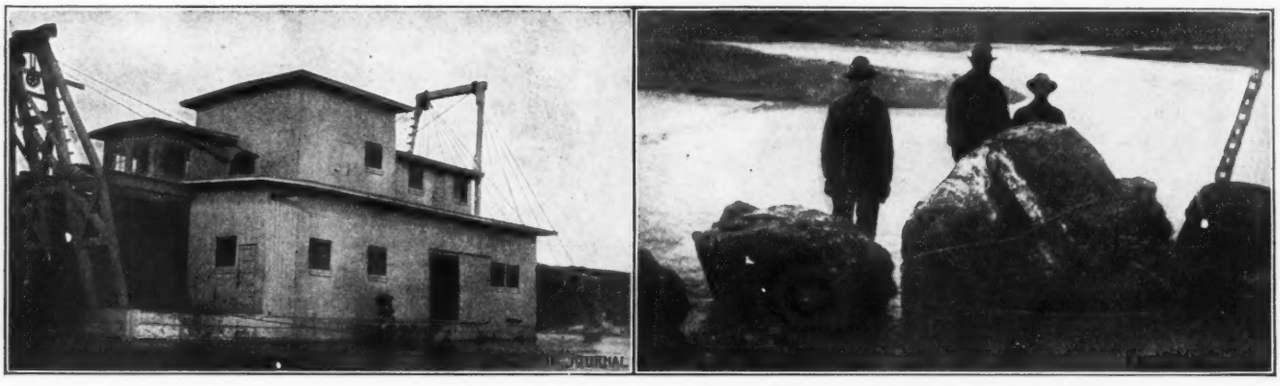
Two Views of the 3cu.ft. Dredges of Inmachuck Company, Inmachuck River, Fairhaven District, Alaska

### Inmachuck Dredge Has Unique Flume

The Inmachuck dredge made a run of 50 days and handled a total of 72,000 cu.yd., bank measurement, of gravel and used 210 gal. of distillate in 24 hr. The

average running time was 97%. The boat is equipped with two 50-hp. gas engines, and a 14-in. centrifugal pump throwing 5500 gal. of water per min. The flume construction is a departure from common practice. It is built of steel and has a double bottom; the lower compartment is equipped for the introduction of steam from a 15-hp. boiler in freezing weather, to prevent the formation of ice on the riffles.

The machinery for the Inmachuck dredge was landed from the steamer at Solomon on July 9, and was hauled by horse teams 26 miles overland to Fairhaven mining district. The dredge started digging on Sept. 2 and was closed down on Oct. 21. The crew immediately started overland for Nome, a distance of 170 miles in order to go out on the last steamer on Oct. 29, traveling



THE RUBY DREDGE OPERATING IN CASADEPOGA RIVER, ALASKA, AND SOME OF THE ROCKS IT HAS TO HANDLE

THE 3-CU.FT. PASADENA DREDGE OPERATING IN BUDD CREEK, PORT CLARENCE DISTRICT, ALASKA

THE 1¾-CU.FT. DREDGE OF THE CANDLE CREEK COMPANY DURING CONSTRUCTION

90 miles by horse team and 80 miles by dog teams. Return to Solomon would have necessitated remaining in Alaska all winter.

One steamer, carrying lumber for the construction of a 3-cu.ft. bucket dredge on Willow Creek on the Arctic Ocean, was delayed in Kugruk River, and was obliged to leave without discharging, as the charter required the steamer to go out on Oct. 1. The lumber was landed at Nome. The machinery will go in and the dredge will be built in the season of 1913, for the Candle Dredging Co.

### LARGE BOULDERS IN CASADEPOGA GRAVEL

The Ruby dredge site is on the Council City & Solomon River R.R. This road is not operated all the way by steam. The road was started at Solomon and was planned to be extended to Council City. The tracks were laid, but only the first 12 miles are kept in repair and operated. The road extends for a distance of 30 miles up the Solomon and over the divide and down the Casadepoga River. The machinery for this dredge was hauled on the steam cars for about half the distance; and then loaded on smaller flat cars and drawn for about 15 miles by horses, one on each side of a car. Six tons were loaded on a car, and with the handling by three men the horses traveled about 15 miles in a day. The dredge started digging on Aug. 14 and closed down on Oct. 14. The ground contains boulders and is hard to dig. The boat averaged about 1000 cu.yd. of gravel and used 140 gal. of distillate in 24 hr. The accompanying halftone indicates the size of rocks taken from the reef. These rocks are first loosened and then rolled over and moved out of the way by the bucket line.

The Candle Creek dredge machinery was landed at Keewallik on July 13, and was towed up Keewallik River on small scows, carrying about two tons, by a gasoline launch a distance of 12 miles. It was then hauled three-quarters of a mile by horse teams. The dredge started digging about Aug. 20. It handled about 600 cu.yd. of gravel and used 110 gal. of distillate in 24 hr. The dredge was designed, and equipped with special size (1¾-cu.ft.) buckets for digging in a cut only 38 ft. wide. The creek had been formerly mined by hand labor, and the digging ground freezes. It was necessary to operate in a narrow cut in order to work the

ground while it is being thawed by driving water in through ditches. The frozen ground also accounts for the shallow depth of the digging.

The Union Construction Co. has built six other gold dredges and one tin dredge in Alaska, prior to 1912, and was the first builder to introduce internal-combustion engines for driving modern-type dredges on Seward Peninsula. The introduction of the silent-chain drive for pumps is another feature of construction which is distinctive in Alaskan dredge practice. The San Francisco office of the company is in the Atlas building. W. W. Johnson is president and has charge of field construction. H. G. Peake is secretary and in charge of the engineering department in San Francisco.

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# Magnetite in Mattes and Slags

By E. W. Walter*

The occurrence of magnetic oxide in mattes and slags has been the subject of considerable speculation among metallurgists and a diversity of opinion exists as to its formation. While a general consensus holds that blast pressure is mainly responsible, through abnormally strong local oxidation at the tuyeres, yet the fact remains that this unwelcome substance occurs in furnaces where such action is at a minimum. Other suggestions and explanations are to the effect that volume of air along with secondary chemical reactions are responsible, yet the almost universal production of magnetic oxide in all kinds of furnaces producing ferrous-silicate slag will not allow this as a full conception.

## The Opinion of Various Authorities

To show that the production of magnetic oxide is general, the following quotations are given, the first from Collins' "Metallurgy of Lead," p. 211:

> It was pointed out by Pearce that certain reverberatory slags at Argo, contained considerable proportions of magnetic material, which he assumed to be magnetite, and to be formed by the oxidizing influence of the furnace gases upon the slag after the reducing effect of sulphur and $SO_2$ had terminated. E. Keller has since shown that much $Fe_3O_4$ (up to 18%) is frequently formed in the slags produced by smelting roasted matte in reverberatory furnaces and smaller amounts are invariably present in matte slags produced in blast furnaces, the atmosphere of which is not sufficiently reducing to destroy this substance before it is taken up by the molten products. When the matte is of low grade, and has a specific gravity not over 5.2 (the specific gravity of magnetite) the latter substance sinks into it in preference to going into the slag. When, however, a high-grade copper or lead matte is being made, the specific gravity of which is over 5.3 or about that, the magnetite cannot enter the matte and is carried away by the slag.

Also in Collins', p. 148, Hampe's published analyses of matte always show oxygen as magnetite and the author's (Collins') analyses of Rio Tinto matte in 1884-85 showed from 4 to 6% of $Fe_3O_4$ present, insoluble in dilute nitric acid. According to some papers, by E. Keller, it appears that the presence of magnetic oxide is almost universal, but the lower the copper contents, the more abundant is the magnetite.

Hofman's "Metallurgy of Lead," p. 138, second edition:

> Last may be mentioned the magnetic property of some lead slags, to which Iles first called attention. This is caused by the presence of magnetite or magnetic sulphide of iron, $Fe_8S_9$. How the magnetic oxide gets into the slag is a matter for further investigation. Hahn suggests an incomplete reduction of ferric oxide.

Peters, "Modern Copper Smelting," p. 229:

> This unlooked for substance is magnetic oxide of iron, which is a frequent, and occasionally important constituent of mattes. It behaves in a manner that appears at first glance somewhat paradoxical, for it seems to be formed most persistently and in the greatest quantities in furnaces where there is the strongest reducing action, and where either a contracted hearth and considerable height of ore column, or a large proportion of sulphur in the charge, would seem to forbid the possibility of any oxidizing influences. It also frequently occurs in lead-furnace matte, in spite of the powerful reducing action resulting from slow smelting, high ore column and contraction of the shaft at the tuyeres. . . . . It is not too rapid nor too slow fusion, nor too much nor too little reduction that causes the formation of magnetic oxide. It is simply too high wind pressure.

Added to the above, it may be stated that my own examination of many slags and mattes of different composition from both lead and copper furnaces invariably showed magnetic oxide—the products produced by pyritic smelting especially.

From the authorities above cited, smelting under different conditions, producing both high- and low-silica slags and mattes of various tenor, utilizing large volume of air with low pressure as in the reverberatory, or large volume with high pressure as in the blast furnace, there is a production of magnetic oxide. It would seem, therefore, that the explanations given, while probably answerable for the specific experiences, yet are not of general application. The formation of magnetic oxide and even metallic iron by blowing air into a bath of matte in a reverberatory furnace has been a common experience, but under conditions rarely encountered in general furnace work.

## Roberts-Austin's Suggestion

In looking up another subject recently, I ran across the following in Roberts-Austin's "An Introduction to the Study of Metallurgy," p. 273, under "oxidizing agents":

> Ferrous silicate or ferrous oxide acts as a carrier of atmospheric oxygen. When ferrous silicate containing less than 30% of silica is exposed in a molten state to the action of air, the iron in excess gradually becomes oxidized, and crystals of magnetic oxide are formed. These render the silicate less fusible and fall by their superior density to the bottom of the mass, sometimes as when such a slag covers a bath of impure metal, the magnetite thus formed, gives up its excess of oxygen to the elements in the metal to be refined and again becomes ferrous oxide and thus acts as a carrier of atmospheric oxygen to the carbon which has to be oxidized.

Have we not here the solution for the formation of magnetic oxide in furnaces producing ferrous-silicate slags? In smelting roasted ores containing a high percentage of iron oxide in the reverberatory or smelting such ores or iron-copper pyrites in the blast furnace, the easily fusible ferrous silicates first form. There are undoubtedly subsilicates containing varying percentages of silica considerably less than 30% formed. The more rapid the smelting, indicating a fusible charge with high-iron content, the more likelihood of such subsilicates forming. The subsilicates of iron being unstable and exposed to the air blast in a more or less molten state, the iron in excess of the quantity required to produce the true ferrous silicate, becomes oxidized and forms the crystals of magnetic oxide. While some of such crystals may be reduced and form ferrous oxide and release their

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oxygen, yet it is highly probable that a part at least sinks through the mass unaffected and contaminates the slag and matte as indicated above, and explained by E. Keller.

In this manner, except in the cases of excessive local oxidation, where the production of magnetic oxide is easily explainable, the above solution of the occurrence of this compound in slags and mattes produced by the ordinary methods of smelting is generally applicable. When one considers the almost universal formation of magnetite in slags and mattes to a greater or lesser degree, independent of furnace construction, slag or matte composition, and with the exception as stated, blast volumes, the explanation as given appears satisfactory.

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## Cement Industry Prospered in 1912

The manufacturers of portland cement enjoyed a prosperous year in 1912, owing to a steady demand and better prices in the last half of the year. Beginning with an early spring and ending with a late fall, the year afforded an unusually long building season.

Cement stocks on hand in January were rather heavy, but they were quickly absorbed; by May, not more than half the customary amount was being put into storage; by August, some mills, notably in the Illinois and Kansas districts, had booked orders up to their full capacity for the rest of the year. In October, contractors began to complain of slowness in delivery. At no time of the year were quotations made covering delivery more than three months in advance. In the Southwest, the demand exceeded the supply throughout the entire year.

In January, prices at New York were $1.25@1.33 per bbl., less 40c. for bags returned; this was equivalent to 57@65c. per bbl. at the mill, but no long-time contracts were made at these prices. In April, an advance of about 5c. per bbl. occurred, with demand becoming more active throughout the country. A few manufacturers seemed anxious to unload heavily at this advance, for which reason, probably, no further increase took place for the next three months, in spite of active demand. In July, prices advanced 10c. more, or to about 67c. per bbl. in bulk at the mill. In August, premiums began to be asked on long-time delivery; a large contract for 1913 was placed at $1.10 per bbl. at New York. In September, rapid advances occurred, carrying the price in the Lehigh Valley to 90c. per bbl. in bulk at the mills, equivalent to $1.18 at New York. A 1,000,000-bbl. contract for the Panama Canal was let at this time to a bidder at 95c., at mill, as compared with a price of 60c. on the previous similar contract. No further advance occurred during the remaining months, and the year closed with mills operating at capacity and disposing of their product at a firm price of 90c. per barrel.

President Morron, of the Atlas Co., says: "The industry is in a splendid condition. Prices are firm and I expect to see them higher in the coming year. Projected construction at beginning of 1913 will require 3,000,000 to 4,000,000 bbl. more than at the same time last year. Demand is growing in all lines, and availability for all kinds of construction is more and more recognized. Use in road building is creating a constantly growing market. Some idea of enormous consumption for this purpose in future may be gained from the fact that 2500 to 3000 bbl. of material is required to each mile of road."

The reduction of the Canadian import duty on cement from 50c. to 26c. per bbl. was expected to cause heavier shipments from the United States across the border. Whatever effect this had was confined to the Western provinces. The mills in the Eastern United States do not command advantageous freight rates into Canada, and further, the Canadian Cement Co. is strong enough to hold its customers in the face of a diminished tariff, the reduction being only temporary.

### Natural Cement

The opening months of 1912 gave no indication of the prosperity enjoyed throughout the remainder of the year by the makers of natural cement. During January, February and March, prices stood stationary at 80c. per bbl. in New York and $1.05 in Boston, with light demand. With the opening of the building season in April, demand became brisk and prices advanced 5c. per bbl. During May and June, more natural cement was sold than in a corresponding time for many years past, while July found the producers working at capacity and selling their whole output at a firm price of 85c. in New York and $1.10 in Boston. In August, the price at Boston fell off 5c., remaining at $1.05 for the rest of the year, while the New York price stood steady at 85c. Sales remained active up to the close of the year, a large part of the output being consumed by telephone companies.

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## Cobalt Oxide

The trade in cobalt oxide is closely controlled, and the price during 1912 has been held at 80c. per lb., without change. For 1913, an advance has been made, and 90c. has been announced as the figure for the coming year's contracts. Except for the imports by the International Nickel Co.'s subsidiaries, there is but little cobalt oxide imported. There is a duty of 25% on the commercial article, but a few customers cling to the established European brands and are willing to pay the premium their use entails.

There is some recovery from the Cobalt-district ores, but by no means so great as would be possible with a more widely extended use of the metal. There is no production of the metal as a byproduct of copper refining. Statistics of production are not available, nor are those for stocks, but it is reported that there are over 3,000,000 lb. of cobalt-nickel residues at the Canadian and American refineries treating Cobalt ores. Interest attaches to experiments being made by the Canadian government to test the application of cobalt as an alloy for steel. The results are reported encouraging, but as the metal should behave practically as nickel does because of its chemical similarity, the final outcome is likely to be only a market on the basis of the prices of nickel, that is, from 30 to 40c. per lb. for the metal.

Continued successful experiments with cobalt as an alloy with tin or chromium to produce special metals for cutlery, etc., and with cobalt salts as paint driers have been made, and an outlet for some of the cobalt products in this direction may be looked for. The chief present use of cobalt is as a coloring for blue glass and for pottery enamel.

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**An Amethyst Placer** has been discovered eight miles from Kreposti-Kushka, in Transcaspia, according to the Mining Journal, Nov. 23, 1912. It is reported that the samples taken show the amethysts to be of high quality.

# Metallurgy of the Homestake Ore—II

*SYNOPSIS—All slime produced in the various mills of the Homestake company is treated in the Deadwood slime plant, where Merrill pressure filters are exclusively used. Zinc-dust precipitation is employed. The cyanide precipitate is acid treated, briquetted and cupelled, a blast furnace being used for the reduction of byproducts. The low cost of treatment is noteworthy.*

The slime from the various cones is thickened in pointed-bottom tanks to about 35% solids, and flows to the Deadwood slime plant in cast-iron pipes. There it is delivered into the sludge tanks, of which there are two, each 26 ft. diameter and 24 ft. deep, with cone bottoms. These tanks are connected through a "Y" with a 12-in. pipe which leads to the constant-pressure tank, 16 ft. diameter and 15 ft. deep. All the slime goes into these tanks, there being no separation of slime from various mills as in former practice. The constant-pressure tank connects with the sludge tanks through a valve operated by a float and is automatically supplied with slime as required.

### Adding Lime to Neutralize Acidity

Lime is prepared by slaking in tubs 8 ft. in diameter and 2.5 ft. deep, a charge of about 500 lb. being slaked in one of the tubs and drawn from it as a thick cream through a perforated plate to the lime agitation tank, 8 ft. in diameter and 5.5 ft. deep, where revolving arms keep it in suspension. Water is added to the agitated pulp, which is continuously drawn off and mixed with the slime entering the sludge tanks. As a high acidity must be neutralized in a brief time, large particles of lime could not be used without waste. The slaked lime, though, is too fine and soluble and tests of water displaced during filling of the presses show that about 12% of it is wasted here. This percentage is somewhat reduced by using part of this water later as a wash.

The slime enters the Merrill presses from an 11-in. main pipe from which two 6-in. laterals, at right angles to the main, lead to the front and follower ends of the press. The former is a pipe connection, the latter a heavy rubber hose, to allow some flexibility. In filling the press the water passes through the cloths and is partly run to waste and part saved for washing the cake, as mentioned. Filling is completed in about 70 minutes, the exact point being determined by **measuring** the amount of water discharged in a given time. The feed inlets and solution and water outlets are then closed and treatment begins.

The time given for treatment varies according to the leaching rate, it being the object to pass equal amounts of solution through **the cakes** irrespective of the leaching rate. The latter is an empirical standard and is taken as the number of seconds required to discharge 5 U. S. gal. from the press under the standard washing pressure.

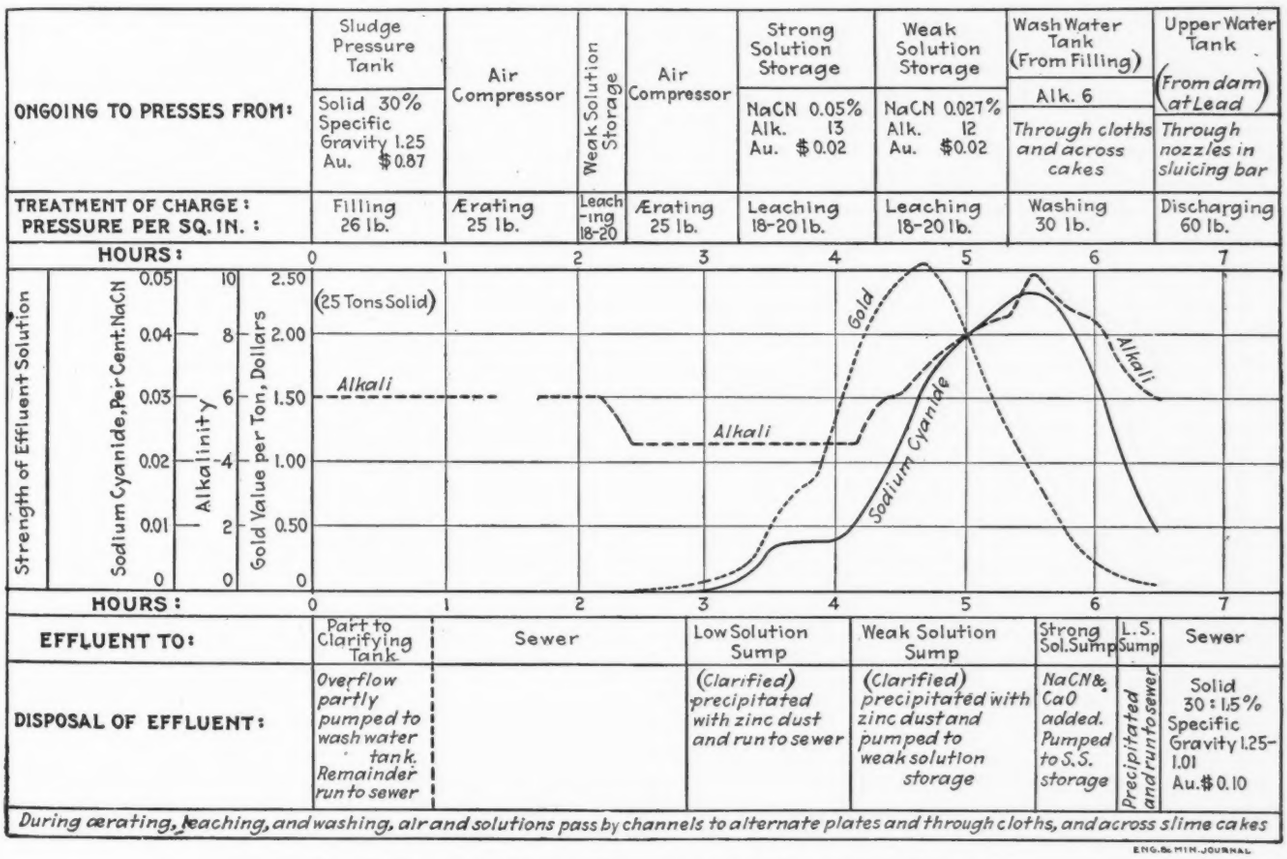
ONGOING TO PRESSES FROM:
Sludge Pressure Tank
Solid 30% Specific Gravity 1.25 Au. $0.87
Air Compressor
Weak Solution Storage
Air Compressor
Strong Solution Storage
NaCN 0.05% Alk. 13 Au. $0.02
Weak Solution Storage
NaCN 0.027% Alk. 12 Au. $0.02
Wash Water Tank (From Filling)
Alk. 6
Through cloths and across cakes
Upper Water Tank (From dam at Lead)
Through nozzles in sluicing bar
TREATMENT OF CHARGE:
PRESSURE PER SQ. IN.:
Filling 26 lb.
Ærating 25 lb.
Leaching 18-20
Ærating 25 lb.
Leaching 18-20 lb.
Leaching 18-20 lb.
Washing 30 lb.
Discharging 60 lb.
HOURS: 0 1 2 3 4 5 6 7
Strength of Effluent Solution
Sodium Cyanide, Per Cent. NaCN
Alkalinity
Gold Value per Ton, Dollars
(25 Tons Solid)
Alkali
Gold
Sodium Cyanide
Alkali
HOURS: 0 1 2 3 4 5 6 7
EFFLUENT TO:
Part to Clarifying Tank
Sewer
Low Solution Sump
Weak Solution Sump
Strong Sol. Sump
L.S. Sump
Sewer
DISPOSAL OF EFFLUENT:
Overflow partly pumped to wash water tank. Remainder run to sewer
(Clarified) precipitated with zinc dust and run to sewer
(Clarified) precipitated with zinc dust and pumped to weak solution storage
NaCN & CaO added. Pumped to S.S. storage
Precipitated and run to sewer
Solid 30 : 1.5% Specific Gravity 1.25-1.01 Au. $0.10
During ærating, leaching, and washing, air and solutions pass by channels to alternate plates and through cloths, and across slime cakes
ENG. & MIN. JOURNAL

Fig. 3. Cycle of Slime Treatment at Homestake Plant

Note—Abstract of a paper by A. J. Clark and W. J. Sharwood presented before the Institution of Mining and Metallurgy, Nov. 21, 1912.

A charge is treated according to the leaching rate shown by the previous charge. The leaching rate is affected chiefly by the accumulation of carbonate of lime on the filter cloths.

The first solution used here is the freshly precipitated weak solution and not the rich strong solution used at the sand plants. This is on account of a shrinkage which takes place in the cake during the first long period of aëration, allowing the solution to pass around the slime cake for about 10 min., until the cake has absorbed enough solution to restore it to its original bulk. Table VIII shows a schedule of treatment details and Fig. 3 the cycle of slime treatment. Table IX shows the effluent solutions from a charge leached first with pregnant strong solution illustrating the result when that solution is used first.

After the period shown the water is displaced and the gold content rises rapidly. This short-circuiting necessitated the taking of all effluent to precipitation before wasting, which caused expense by requiring cyanide to maintain the strength of the low solution at about 0.015 NaCN, and the solution passing to precipitating tank, but carrying no gold, was handled at a loss. A reference

TABLE VIII. SCHEDULE OF FILTER OPERATIONS

| Class of press | A | | B | | C | |
|---|---|---|---|---|---|---|
| Approximate per cent. of all presses in this class | 50.0 | | 40.0 | | 10.0 | |
| Leaching rate | 7 or faster | | 8 and 9 | | 10 or slower | |
| | Hr. | Min. | Hr. | Min. | Hr. | Min. |
| Air | 1 | 0 | 1 | 20 | 1 | 30 |
| Weak solution | 0 | 25 | 0 | 30 | 0 | 35 |
| Air | 1 | 0 | 1 | 0 | 1 | 20 |
| Strong solution | 1 | 0 | 1 | 20 | 1 | 30 |
| Weak solution | 0 | 50 | 1 | 30 | 1 | 40 |
| Water | 12 or 13 tons in all cases, according to time available. | | | | | |

TABLE IX. ANALYSES OF FILTER SOLUTIONS

| | Strength NaCN, % | | Gold Per Ton $ |
|---|---|---|---|
| Ongoing solution | 0.08 | .... | 0.60 |
| Effluent after 10 min | 0.04 | .... | 0.30 |
| Effluent after 20 min | 0.01 | .... | 0.10 |
| Effluent after 30 min | Trace | .... | 0.01 |
| Effluent after 60 min | Trace | .... | 0.05 |
| Effluent after 80 min | 0.005 | .... | 0.09 |

to the chart, Fig. 3, shows that the use of barren solution at the start of treatment allows the valueless solution to be wasted, although it requires the precipitation of a larger amount of low-grade solution, the amount enriched by being passed twice through the slime cake being diminished. Table X shows the result of four months of experiment leading to a reduction of the working strength of solution to the present standard of 0.06% NaCN.

The standard cloth for filters is a light muslin twill placed in contact with the corrugated surface of the plate and a No. 10 cotton duck covering this. Single cloths are forced into the corrugations and retard circulation. Presses have run for more than a year without developing a leak, and some have been in service three years without reclothing. The average life of the last 26 suits removed was 21 months.

Deposits of calcium carbonate formed on the cloths reduce their permeability and acid treatment is resorted to frequently. Weak HCl, containing about 0.75% HCl, is put into the empty press, run in through the sluicing bar and both lower channels, thus reaching both sides of the cloth. This is allowed to remain four hours, after which it is removed and treatment continued. Only traces of the acid remain, and the iron of the press is not appreciably attacked.

Judged by the decreasing permeability of the cloths, a certain amount of $CaCO_3$ doubtless remains in the meshes of the cloth. Figs. 4 and 5 show the performance of typical presses in relation to the effect of lime formation and acid treatment. Fig. 6 shows a chart of a typical sluicing. The sluicing is accomplished by means of the sluicing bar, which is a feature of the Merrll press. The

TABLE X. RESULTS OF VARYING STRENGTH OF SOLUTION

| | January | February | March | April |
|---|---|---|---|---|
| Using as first solution | Bar. W.S. | Bar. W.S. | Bar. W.S. | Bar. W.S. |
| Strength, NaCN | 0.075% | 0.168% | 0.06% | 0.053% |
| Tons preg. L.S. per ton slime | 0.294 | 0.26 | 0.24 | 0.26 |
| Strength of L.S., in NaCN | 0.02% | 0.018% | 0.015% | 0.012% |
| NaCN lost, lb. per ton of slime— | | | | |
| In low solution | 0.117 | 0.095 | 0.072 | 0.062 |
| In residue | 0.020 | 0.018 | 0.017 | 0.013 |
| Unaccounted for (decomposition) | 0.105 | 0.095 | 0.094 | 0 086 |
| Added to L.S. to raise strength before precipitating | ..... | ..... | ..... | 0.016 |
| Total | 0.242 | 0.208 | 0.183 | 0.177 |

bars are removed at intervals of six weeks and tested in order to be sure that all nozzles are open and in correct alignment. The average sluicing requires a little more than four tons of water to remove a ton of slime. About

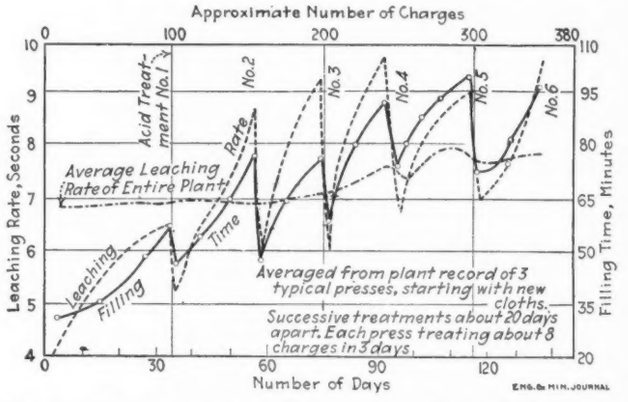
Approximate Number of Charges
Leaching Rate, Seconds
Filling Time, Minutes
Number of Days
Acid Treatment No. 1
No. 2
No. 3
No. 4
No. 5
No. 6
Average Leaching Rate of Entire Plant
Leaching Rate
Filling Time
Averaged from plant record of 3 typical presses, starting with new cloths.
Successive treatments about 20 days apart. Each press treating about 8 charges in 3 days.
ENG. & MIN. JOURNAL

FIG. 4. EFFECT OF ACID TREATMENT UPON PERMEABILITY OF FILTER CLOTHS

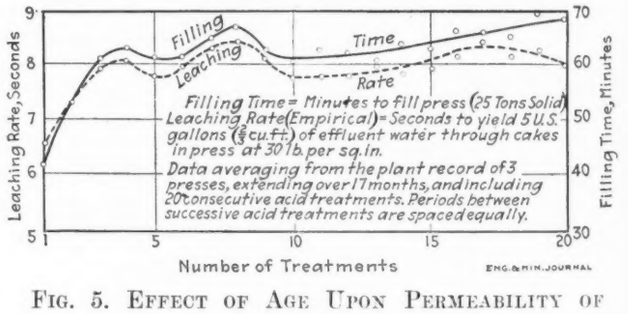
Leaching Rate, Seconds
Filling Time, Minutes
Number of Treatments
Filling
Leaching
Time
Rate
Filling Time = Minutes to fill press (25 Tons Solid)
Leaching Rate (Empirical) = Seconds to yield 5 U.S. gallons (⅔ cu. ft.) of effluent water through cakes in press at 30 lb. per sq. in.
Data averaging from the plant record of 3 presses, extending over 17 months, and including 20 consecutive acid treatments. Periods between successive acid treatments are spaced equally.
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FIG. 5. EFFECT OF AGE UPON PERMEABILITY OF FILTER CLOTHS

1700 tons of slime are treated daily at the slime plant, with a power charge of 120 hp., of which 75% is used in compressing air. The water consumption is shown in Table XI.

## ZINC-DUST PRECIPITATION USED

Due to methods already explained, the volume of solution required for treatment is relatively small and only a portion of this solution is precipitated. The quantity

TABLE XII. TONS SOLUTION PER TON MATERIAL TREATED

| Plant | All Sol. | Low Sol. (Pptd & wasted) | Weak Sol. (Pptd & reused) | Strong Sol. (Not Pptd.) |
|---|---|---|---|---|
| No. 1 sand | 0.883 | 0.089 | 0.351 | 0.443 |
| No. 2 sand | 0.611 | 0.128 | 0.237 | 0.246 |
| Slime | 1.040 | 0.261 | 0.451 | 0.328 |
| All plants | 0.900 | 0.168 | 0.372 | 0.360 |

of these solutions used during April, 1911, in tons per ton of material treated, is shown in Table XII.

In Table XIII are given analyses of typical solutions from the various plants. In all plants the Merrill system of zinc-dust precipitation is used. The zinc dust is fed continuously by means of an appropriate feeder into a small stream of solution by which it is carried to a point just outside the solution tank, where it meets the main

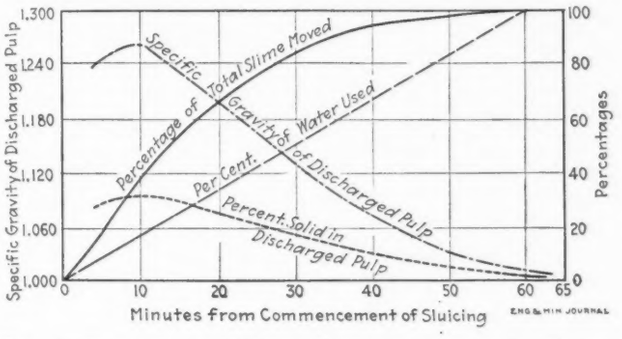


FIG. 6. SLUICING OF MOIST SLIME CAKES FROM FILTER PRESSES

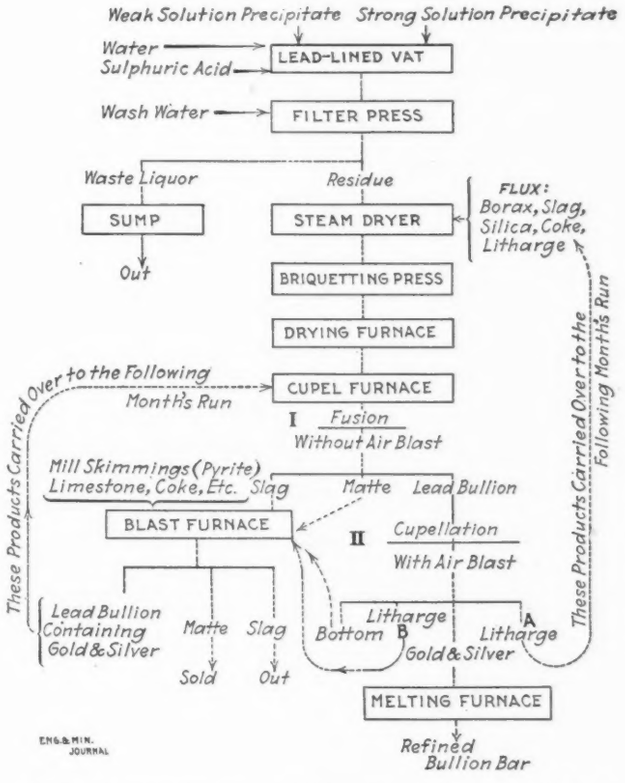


FIG. 7. REFINING OF PRECIPITATE, HOMESTAKE MINE

stream of pregnant solution and flows with it to the filter press. It is general practice to feed a small stream or drip of lead nitrate solution to the feed pipe carrying the

TABLE XI. WATER CONSUMPTION AT SLIME PLANT

| Water used for | Tons Water per 24 hours | Water derived from |
|---|---|---|
| Lime feed | 50 | Clarified cone overflow. |
| Washing slime cakes | 850 | Alkaline water displaced from slime during filling. |
| Discharging residues | 7000 | Clarified cone overflow. |
| Compressor jackets | 400 | New water from city mains. |
| Acid treatment | 50 | Clarified cone overflow. |
| Miscellaneous | 40 | New water from city mains. |
| | 8390 | |

zinc emulsion, but this is not done when the silver content of the solution is above the normal. The nitrate of lead is a little cheaper than the acetate per unit of lead con-

TABLE XIII. ANALYSES OF SOME TYPICAL CYANIDE SOLUTIONS

Percentage = grams. in 100 cc.

(1) Solution used about three years on sand coming mainly from oxidized ore; weak solution, Plant No. 2. (2) Same; strong solution, Plant No. 2. (3) Solution used about five years on tailing sfrom mixed ore, mostly unoxidized; weak solution, Plant No. 1. (4) Same; strong solutiou, No. 1. (5) Solution after using about nine years, sampled after a considerable period of deep level, highly sulphuretted ore. The high reducing power is noteworthy; it at one time reached 550, or about 0.9%, KCNS. Weak solution, Plant No. 1. (6) Weak solution, Slime Plant.

| Sample No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Usual Plant Determinations:— | | | | | | |
| Available KCN, % | 0.075 | 0.12 | 0.05 | 0.115 | 0.065 | 0.05 |
| Total KCN, % | 0.135 | 0.165 | 0.09 | 0.15 | 0.095 | 0.06 |
| Reducing power* | 25.5 | 24.3 | 117.5 | 117.0 | 333.0 | 14.0 |
| Alkalinity† | 11.5 | 21.0 | 11.5 | 20.0 | 14.0 | 9.0 |
| Protective alkali (Lb. CaO per ton) | 0.0 | 0.144 | 0.214 | 0.131 | 0.225 | 0.07‡ |
| Additional Determinations: | | | | | | |
| Total CN (by HgO), % | 0.058 | 0.076 | 0.048 | 0.058 | 0.040 | 0.025 |
| CNS (thiocyanate), % | 0.024 | 0.024 | 0.102 | 0.105 | 0.319 | 0.012 |
| $SO_4$ (sulphate) % | 0.014 | 0.020 | 0.040 | 0.041 | 0.041 | 0.010 |
| S (sulphide) % | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| S in other forms (by difference) % | ..... | ..... | ..... | ..... | 0.002 | 0.004 |
| Ca, % | 0.066 | 0.062 | 0.051 | 0.049 | 0.072 | 0.028 |
| Na‡, % | ..... | ..... | ..... | 0.063 | 0.188 | ..... |
| K, % | ..... | ..... | ..... | 0.044 | 0.148 | ..... |
| Zn, % | 0.032 | 0.023 | 0.028 | 0.022 | 0.014 | 0.004 |
| Cu, % | 0.006 | 0.006 | 0.003 | 0.005 | 0.004 | Trace |
| Fe (in ferrocyanide) % | 0.00015 | 0.00015 | 0.0002 | 0.0002 | 0.0002 | 0.00005 |
| Alkalinity:—† | | | | | | |
| Direct by phenol-phthalein | 11.5 | 21.0 | 11.5 | 20.0 | 14.0 | 9.0 |
| Back titration phenol-phthalein | 25.0 | 31.5 | 24.0 | 33.5 | ..... | ..... |
| Direct by methyl orange | 32.0 | 39.0 | 28.0 | 36.0 | ..... | ..... |
| Back titration methyl orange | 37.0 | 41.0 | 34.0 | 42.0 | ..... | ..... |

Hg, Mg, Al, Si: traces found in all solutions examined for them; Mn not found.

* No cc. N/10 permanganate consumed by 100 cc. † No cc. N/10 acid neutralized by 100 cc.

‡ Mixed cyanide rather high in K was in use in the periods represented.

tained. In some instances the solution is pumped through the filter presses, but where conditions will allow it, the flow is by gravity.

Filter presses are of the usual Merrill triangular plate-and-frame design. Some rectangular presses are still in use, and while there is little difference in the amount of zinc used in either case, the triangular frame will deliver a higher-grade precipitate, due probably to the agitation secured in it.

The plates are covered with two thicknesses of twilled cotton cloth, which remains undisturbed during the month between cleanups. After opening the press the precipitate is scraped off and the cloth is burned, the ash going in with the precipitate. The inside cloth is then moved up to take the place of the one burned and a new one placed in the inside position. Sometimes the outside cloth is washed in HCl instead of burning it, refining the washings with the rest of the precipitate, while the cloth is returned for two months' further service.

Two solution sumps are maintained at each plant, one filling while the other is being pumped out and precipitated. This system allows a measurement of the solution precipitated and insures an even feed of zinc dust. Its adverse features are occurrence of intervals during which no precipitation is taking place, running the risk of re-solution precipitation of lime carbonate, and when the period is long, of oxidation of the zinc. These difficulties are comparatively easily controlled and their total effect should not be more than a slight increase in the amount

of zinc dust required for satisfactory precipitation. Table XIV presents a summary of precipitation practice.

### Precipitate Is Acid Treated Before Melting

The precipitate is removed from the presses once each month, the presses being blown with air for two hours previous to opening in order to displace all possible moisture. The precipitate is dropped into shallow boxes which are run under the press. It is sampled and weighed and is ready for acid treatment. Two men will clean and reassemble a 30-frame press containing up to 2000 lb.

In treating precipitate a small amount of water is run into the tank, the agitators started and then precipitate added, about 200 lb. at a time, the acid following as required. The operation is controlled by adding water if the reaction becomes too violent. The treatment is continued until action is practically complete, the supernatant liquor decanted off, the tank filled with water and agitated again, repeating the decanting operation. The whole is then forced through the press, washed and blown, after which the precipitate is removed to the dryer.

TABLE XIV. PRECIPITATION AT THE CYANIDE PLANTS OF THE HOMESTAKE MINING CO.

| Period | Plant | Weak Solution: Tons per Ton treated | Assay Pregnant $ per ton | Assay Barren $ per ton | Zinc Dust Lb. per ton sol'n prec'd | Zinc Dust Lb. per oz. gold prec'd | Low Solution: Tons per Ton treated | Assay Pregnant $ per ton | Assay Barren $ per ton | Zinc Dust Lb. per ton sol'n prec'd | Zinc Dust Lb. per oz. gold prec'd | All Solution Precipitated: Tons per Ton treated | Assay Pregnant $ per ton | Assay Barren $ per ton | Zinc Dust Lb. per ton treated | Zinc Dust Lb. per ton sol'n prec'd | Zinc Dust Lb. per oz. gold prec'd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| April, May-Aug., 1910. | No. 1 sand | 0.368 | 2.67 | 0.03 | 0.225 | 1.75 | 0.82 | 0.30 | 0.02 | 0.15 | 11.08 | 0.45 | 2.26 | 0.03 | 0.095 | 0.212 | 1.99 |
| | No. 2 sand | 0.248 | 2.34 | 0.04 | 0.25 | 2.23 | 0.112 | 0.29 | 0.01 | 0.13 | 9.52 | 0.36 | 1.71 | 0.03 | 0.076 | 0.212 | 2.61 |
| | Slime | 0.34 | 1.62 | 0.05 | 0.135 | 1.80 | 0.345 | 0.40 | 0.01 | 0.153 | 8.12 | 0.685 | 1.00 | 0.03 | 0.099 | 0.145 | 3.07 |
| | All | 0.335 | 2.17 | 0.04 | 0.19 | 1.84 | 0.198 | 0.37 | 0.013 | 0.15 | 8.61 | 0.533 | 1.50 | 0.03 | 0.094 | 0.175 | 2.46 |
| April, 1911. | No. 1 sand | 0.351* | 3.34 | 0.02 | 0.128 | 0.795 | 0.089 | 0.28 | 0.01 | 0.145 | 11.48 | 0.44 | 2.72 | 0.018 | 0.058 | 0.131 | 1.00 |
| | No. 2 sand | 0.237* | 2.48 | 0.07 | 0.173 | 1.49 | 0.128 | 0.50 | 0.01 | 0.112 | 4.65 | 0.365 | 1.79 | 0.048 | 0.055 | 0.151 | 1.80 |
| | Slime | 0.451* | 1.54 | 0.041 | 0.123 | 1.69 | 0.261 | 0.40 | 0.02 | 0.197 | 10.54 | 0.712 | 1.12 | 0.033 | 0.107 | 0.150 | 2.82 |
| | All | 0.372 | 2.33 | 0.036 | 0.130 | 1.16 | 0.168 | 0.39 | 0.015 | 0.174 | 11.01 | 0.540 | 1.72 | 0.03 | 0.078 | 0.144 | 1.78 |
| Sept., 1911. | No. 1 sand | 0.329 | 3.695 | 0.018 | 0.181 | 1.02 | 0.097 | 0.385 | 0.018 | 0.144 | 8.08 | 0.426 | 2.94 | 0.018 | 0.073 | 0.173 | 1.22 |
| | No. 2 sand | 0.177 | 3.984 | 0.041 | 0.200 | 1.06 | 0.091 | 0.470 | 0.021 | 0.120 | 5.49 | 0.268 | 2.772 | 0.034 | 0.046 | 0.174 | 1.31 |
| | Slime | 0.497† | 1.550 | 0.035 | 0.148† | 2.02† | 0.266 | 0.514 | 0.017 | 0.183 | 7.63 | 0.763 | 1.188 | 0.028 | 0.122 | 0.160 | 2.84 |
| | All | 0.369 | 2.490 | 0.030 | 0.164 | 1.37 | 0.166 | 0.480 | 0.018 | 0.167 | 7.49 | 0.535 | 1.867 | 0.026 | 0.089 | 0.165 | 1.84 |

* Modified system of zinc feed in use with these solutions. † Inferior zinc dust.

TABLE XV. CLEANUP DATA FOR MAY, 1911 AT HOMESTAKE CYANIDE PLANTS

| | Percentage of Weight of Dry Precipitate: Cy. 1. Weak Sol'n | Cy. 2. Low Sol'n | Cy. 2. Weak Sol'n | Cy. 2. Low Sol'n | Average Raw | Acid Treat'd | Total Pounds Weight of Constituents: Cy. 1. Weak Sol'n | Cy. 1. Low Sol'n | Cy. 2. Weak Sol'n | Cy. 2. Low Sol'n | Average Raw | Acid Treat'd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total weight | 1376 | 324 | 622 | 160 | 2482 | 1425 | 1376 | 324 | 622 | 160 | 2482 | 1425 |
| Gold | 13.20 | 1.65 | 7.20 | 2.40 | 9.50 | 16.55 | 181.63 | 5.35 | 44.78 | 3.84 | 236.60 | ..... |
| Silver | 4.45 | 0.78 | 2.86 | 0.91 | 3.34 | 5.83 | 61.23 | 2.53 | 17.79 | 1.45 | 83.00 | ..... |
| Lead | 9.85 | 11.4 | 6.6 | 12.9 | 9.45 | 16.7 | 136.0 | 37.0 | 41.0 | 20.6 | 234.6 | 238.0 |
| Zinc | 37.6 | 53.3 | 49.8 | 57.8 | 44.0 | 19.9 | 517.4 | 172.7 | 310.0 | 92.5 | 1092.6 | 283.5 |
| Calcium | 4.8 | 4.8 | 3.6 | 2.9 | 4.37 | 4.6 | 66.0 | 15.5 | 22.4 | 4.6 | 108.5 | 65.5 |
| Copper | 0.35 | 0.85 | 0.45 | 1.10 | 0.7 | 0.7 | 4.8 | 2.75 | 2.8 | 1.75 | 12.1 | 9.8 |
| Iron | 0.38 | 0.10 | 0.40 | 0.43 | 0.37 | 0.40 | 5.2 | 0.3 | 2.5 | 1.2 | 9.2 | 5.7 |
| Mercury | 0.05 | 0.02 | 0.20 | 0.23 | 0.095 | 0.10 | 0.69 | 0.06 | 1.24 | 0.37 | 2.36 | 1.3 |
| Sulphate ($SO_4$) | 1.05 | 0.51 | 0.37 | 0.54 | 0.77 | 19.82 | 14.5 | 1.6 | 2.3 | 0.8 | 19.3 | 282.6 |
| Sulphur as sulphide, etc | 9.51 | 2.96 | 2.40 | 1.96 | 6.38 | 6.35 | 131.0 | 9.6 | 14.9 | 3.1 | 158.6 | 90.5 |
| Carbonate ($CO_3$)* | 7.2 | 7.7 | 7.2 | 5.5 | 7.23 | 0.0 | 101.1 | 25.0 | 44.8 | 8.8 | 179.7 | 0.0 |
| Insoluble | 1.27 | 0.88 | 0.67 | 1.83 | 0.95 | 1.81 | 17.5 | 2.8 | 4.2 | 2.9 | 27.4 | 25.8 |

*Carbonate determined by a roughly approximate method.

TABLE XVII. COSTS AT CYANIDE PLANTS, JANUARY-FEBRUARY, 1911, PER TON TREATED

| | No. 1 Sand Plant; 93,262 Tons: Labor | Power | Chemicals | Other Supplies | All | No. 2 Sand Plant: 43,609 Tons: Labor | Power | Chemicals | Other Supplies | All | Slime Plant: 99,300 Tons: Labor | Power | Chemicals | Other Supplies | All |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| Transportation | 0.0013 | .... | .... | 0.0015 | 0.0028 | 0.0027 | .... | .... | 0.0001 | 0.0028 | .... | .. | .... | .... | .... |
| Classification | 0.0092 | 0.0020 | .... | 0.0001 | 0.0113 | 0.0142 | .... | .... | .... | 0.0142 | .... | .... | .... | .... | .... |
| Thickening | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 0.0035 | .... | .... | .... | 0.0035 |
| Neutralization | 0.0021 | 0.0005 | 0.0188 | .... | 0.0214 | 0.0038 | 0.0003 | 0.0191 | .... | 0.0232 | 0.0057 | 0.0004 | .... | 0.0001 | 0.0062 |
| *Treatment | 0.0341 | 0.0177 | 0.0939 | 0.0034 | 0.1491 | 0.0332 | 0.0092 | 0.0502 | 0.0031 | 0.0957 | 0.0383 | 0.0181 | 0.0653 | 0.0138 | 0.1355 |
| †Precipitating | 0.0059 | 0.0015 | 0.0041 | 0.0008 | 0.0123 | 0.0057 | 0.0009 | 0.0038 | 0.0005 | 0.0109 | 0.0070 | 0.0017 | 0.0067 | 0.0011 | 0.0165 |
| ‡Miscellaneous | 0.0014 | 0.0016 | .... | 0.0109 | 0.0139 | 0.0028 | 0.0005 | .... | 0.0107 | 0.0140 | 0.0066 | 0.0013 | .... | 0.0054 | 0.0133 |
| Assaying | 0.0039 | .... | 0.0010 | 0.0014 | 0.0063 | 0.0045 | .... | 0.0002 | 0.0005 | 0.0052 | 0.0023 | .... | 0.0007 | 0.0011 | 0.0041 |
| Refining | 0.0032 | .... | 0.0011 | 0.0009 | 0.0052 | 0.0028 | .... | 0.0010 | 0.0006 | 0.0044 | 0.0038 | .... | 0.0029 | 0.0018 | 0.0085 |
| Superintendence | 0.0074 | .... | .... | .... | 0.0074 | 0.0115 | .... | .... | .... | 0.0115 | 0.0099 | .... | .... | .... | 0.0099 |
| All | 0.0685 | 0.0233 | 0.1189 | 0.0190 | 0.2297 | 0.0812 | 0.0109 | 0.0743 | 0.0155 | 0.1819 | 0.0771 | 0.0215 | 0.0756 | 0.0233 | 0.1975 |

Combined Costs: All Cyanide Plants: 236,171 Tons

| | $ |
|---|---|
| Labor | 0.0744 per ton treated |
| Power | 0.0203 per ton treated |
| Chemicals | 0.0927 per ton treated |
| Other supplies | 0.0202 pe rton treated |
| | 0.2076 |

Chemicals Consumed During above Period: Lb. per Ton Treated

| | No. 1 Plant | No. 2 Plant | Slime Plant | Combined Consumption, All Plants, |
|---|---|---|---|---|
| | lb. | lb. | lb. | lb. |
| Sodium cyanide | 0.393 | 0.209 | 0.225 | 0.289 |
| Lime | 5.01 | 5.24 | 4.55 | 4.86 |
| Zinc dust | 0.065 | 0.065 | 0.114 | 0.086 |
| Hydrochloric acid | ..... | ..... | 0.499 | ..... |

* Includes filling and discharging. † Includes pumping of all solutions. ‡ Includes heating and lighting.

wet precipitate in two hours, and in this time a third man will have sampled and weighed the precipitate and boxed it for transportation to the acid-treatment plant.

The acid treatment is given in a lead-lined tank 8 ft. 10 in. by 5 ft. 8 in. provided with agitating mechanism, hood and exhaust fan. The tank discharges by gravity into a small montejus from whence it is forced through a filter press. Commercial sulphuric acid of 66° Beaumé strength is used for treatment, being raised by air to the treatment tank.

The dryer is an open box of sheet iron, heated by steam. The precipitate is dried down to about 17% moisture, this being retained to prevent dusting and to form a sound briquette. The flux is then mixed with it, the fluxing elements being intimately mixed before adding them to the precipitate. The flux consists of litharge, borax and old assay slags. Borax glass has been used at times, but if the proportion is too large there is a tendency to absorb moisture from the precipitate and weaken or even break the briquettes.

### Precipitate Is Briquetted and Cupelled

Briquetting is done in a press operated by air pressure at 600 lb. per sq.in. and exerting a pressure on the briquette of about 3500 lb. per sq.in. The briquettes are 5 in. in diameter and 4 in. high, averaging about 7 lb. each. They are placed in a shallow drying pan and passed through a drying furnace, being sufficiently dried in about two hours. An inclosed drying furnace was made necessary by the presence of mercury.

The briquettes are then cupelled in a furnace of the English type, carrying an oval test 4 ft. 1 in. by 3 ft. 6 in. outside measurement, and about 7 in. deep. The frame of the test is of cast iron and is filled with a hearth of cement and limestone, 75% of the former being used. The limestone is sized between 10- and 30-mesh screens.

A blast furnace is provided for melting down byproducts, litharge, old test bottoms, slags, etc. The diagram, Fig. 7, shows the entire process of refining. Tables XV and XVI show the cleanup data. The time occupied in the cleanup was 53.5 hr. from the time of opening the presses until the finished bars were ready for shipment.

### Mill Feeds Not Assayed

The mill feed is not assayed directly but the contents are calculated from the tailing assays and the actual bullion output of the mills. Sand tailings are sampled by boring the tank with a slotted pipe. A wooden core is placed in the pipe and withdrawn after it has been pushed to the bottom of the charge and the sample is taken through the slot. The heads are sampled by taking a sample of the stream of sand pulp while the tank is filling. Slime heads are sampled from the main feed pipe, one being taken when each press commences filling and a general sample being cut from the accumulation of each 24 hours.

TABLE XVI. COST OF BREAKING ORE AT SHAFTS

| | Cost per Ton | | Approximate Percentage of total cost of breaking |
|---|---|---|---|
| Power— | Range Cents | Average $ | |
| Steam power, including labor of engineers, firemen, etc | 3—4 | 0.0351 | 58.5 |
| Attendance— | | | |
| Labor, including the handling of cars from shaft to grizzly | 1—1.5 | 0.0125 | 21.0 |
| Lubricants | 0.08—0.14 | 0.0009 | 1.5 |
| Maintenance— | | | |
| Materials and supplies for repairs and renewals | 0.65—1.2 | 0.0091 | 15.0 |
| Labor on repairs and renewals | 0.14—0.38 | 0.0024 | 4.0 |
| Total | 5.7 —6.6 | 0.0600 | 100.0 |

The cost of distribution of the broken ore to the mills by means of the tramway is approximately 2c. per ton.

The slime-tailing sample is taken by first dividing the slime plant into three sections of 10 presses each; in each section are placed three residue sample buckets, A, B and C, corresponding to the "fast," "average," and "slow" leaching rates of the charges. During the sluicing of each charge a cup sample is caught at the outlet cocks and put into the sample bucket corresponding to its leaching rate.

### Cost of Operations

The cost of stamp milling at the Lead mills for a period of 12 months was as follows: Power (including engineer's labor), 10.4c. per ton crushed; machinery (renewals), 9.4c.; operating labor, 9.1c.; silver plating, 0.5c.; mercury, 0.5c.; repairs (reconstruction of batteries, bins, etc.), 4.1c.; miscellaneous, 0.6c.; total, 34.6c. The cost of regrinding for a three-month period in 1910 was 25.7c. per ton ground, distributed as follows: Power, 6.34c.; labor, 8.08c.; renewals, 10.64c.; miscellaneous, 0.64c. Detailed crushing and cyanide costs are given in the accompanying tables.

## Zinc in Idaho

By Robert N. Bell*

The production of zinc ore in Idaho in 1912 came mostly from two properties, both of which are situated in the Cœur d'Alene district. The Success mine was the principal producer, with an output of ore containing 11,000,000 lb. of zinc. The Morning mine, which operates a MacQuisten-tube plant treating zinc-bearing slimes, made an output of 45% concentrates containing an aggregate amount of 3,197,000 lb. of zinc.

The Success mine yields ore containing about equal percentages of iron and zinc sulphides, with an appreciable amount of lead. It produced about a carload of 42% zinc concentrates per day, and a carload of 50% lead concentrates per week, by ordinary table methods.

Zinc-lead ores are prevalent both at the extreme north and south ends of the Cœur d'Alene, and a number of well developed properties are preparing to enter the market in 1913. The Surprise mine and the Monarch mine in 1912 each shipped 10 cars of ore containing 45% zinc.

New railroad construction to Camas Prairie, near the west end of the Wood River district, in Blaine County, reduced the former wagon haul from Smoky Creek mines half, and will encourage development. This region contains some encouraging showings of zinc-lead ore, which have been dormant for a number of years. The ores in this district carry comparatively high silver and some gold.

## Ocher in 1912

The prices of domestic ocher in 1912 were without any fluctuation, except in one grade, in which an advance of $2.50 was recorded in November. The general prices, f.o.b. New York, run $10.50@20 per quality, the latter figure including the so called "Peruvian ochre." The demand has been running ahead of output recently, and some Southern mines are reported to be four or five months behind orders. As contrasted with the imported ochers, the American goods lack in clearness of tone, opacity, and tinting strength, are less easily reduced to a given fineness, and will run about 10% lower in oxide of iron. We estimate domestic production for the year at 13,500 tons.

The prices of French ocher have been high for the last two years. Beginning with the heavy floods in the valley of the Seine in 1910, the seasons have been so rainy that only about one-half the current output could be dried by solar heat. To dry by artificial heat, as has been necessary, has increased the cost of production about 60 centimes per 100 kg., and as the producers are thoroughly syndicated, this has been promptly passed on to the consumer. The year closed at about $1.25@1.40 per cwt., gross for net, New York docks.

*State mine inspector, Boise, Idaho.

# Cripple Creek in the Early Days

By G. L. Sheldon*

*SYNOPSIS—Cripple Creek was a camp which upset all the theories of the old-time prospectors and assayers, so that the tenderfoot stood as good a chance of a fortune as the expert. Personal reminiscences of the early days there.*

In the early '80's, the Hollingsworth brothers, from the San Juan country, camped under the Independence granite ledge for two weeks, prospecting for silver—no one was looking for gold in those days. The Mt. Pisgah excitement (two miles west of the town of Cripple Creek) which was a salted proposition, brought several hundred people into the district, but no one noticed the gold indications.

In 1890, a Cornish miner discovered the El Paso Gold King mine, up Poverty Gulch, located and did his discovery work, packed 30 to 40 lb. of the ore on his burro to Leadville, and gave it to his assayer, cautioning him to be particular with it, as it was a new discovery that he thought much of. When he returned he was given a certificate of $3 gold per ton. It was so different from what the assayer was accustomed to, it is evident that he threw it out the back door and never tested it, for two years later the rock that the Cornishman left on the dump, and the face of his discovery hole, was shipped and returned $200 per ton; the property is still shipping, but the Cornishman lost out. This was a year before Bob Womack made his discovery, which caused Cripple Creek to be known on the maps of the world.

The conditions, formations and character of the ores were such that up to '93, when Colorado became interested in something else than silver, I know of only one engineer, W. A. Farish, who had any confidence in the camp, or even spoke well of it, the other engineers and all old-time miners were afraid of it; it "did not look good to them." It was the tenderfoot who made the money at Cripple Creek. He jumped in and made locations anywhere; later it proved that any of these in the inside mineral area, three miles square, was valuable. It was a question of trenching on the surface (the débris generally being deep) and finding pay ore, or sinking a shaft and crosscutting the country until pay ore was found. Very few veins were exposed on the surface. I knew a 240-ft. shaft, sunk by leasers, and abandoned, later worked by others, the first round of shots put in at one side at the bottom of the shaft exposed a 2-ft. vein of $100 ore, which was stoped to the surface. There were many cases in the early days, of fortunes lost by not crosscutting the country.

Few of the old-time mining men made money at Cripple—the conditions and formation were so different from what they were accustomed to that they could not "catch on," but it taught most of us to assay anything thereafter. Up to that time, the world had never seen such a boom, especially in wildcat propositions; stock was sold by the wholesale in nearly every city, town and village of the country. While in some instances stocks of properties on the inside area, which first sold for 2, 3, 5 to 10c. per share, eventually from development, ran up to $1 and $2 per share; the great majority, over 90%, were worthless. Practically everything outside of the three miles square mineral area was proved of no value.

I have seen claims in the red Pikes Peak "coarse corn granite," six to eight miles north of Cripple, sold for $100 each, for stock purposes. I recall one instance of Eastern clients wanting information regarding a certain stock, which eventually I found was based on a location stake, situated on a patented claim on Gold Hill. In most cases it was necessary to pay cash for an option on ground situated in the inside, then if you found a buyer, very often he would manage to beat you out of a commission.

The town was run wide open, gambling of all classes flourished all of the 24 hours. One of the early chiefs of police collected $100 per month from each faro and roulette game as his personal perquisite. The loss of $17,000 to Wells, Fargo & Co., by a holdup of the stage, was afterward repaid by a bank to the head detective of Wells, Fargo & Co., on demand, without a protest.

After the two fires in the spring of '96, the better class of citizens organized a vigilance committee of 100, and every dwelling left in the town was searched for lost and stolen property, which was restored, upon identification, to the original owners. All hoboes, crooks and a number of the rough element were rounded up, loaded into box cars, locked, and the railroads, *gratis*, ran them over to the prairies of Kansas, and turned them loose with warnings not to return. I know of but one of these characters, "Pick Handle Jack," who returned; it fared hard with him. For several months before the fires, the town was so crowded that if one had a friend coming, it was necessary for him to wire two or three days ahead, in order to secure a bed. Joe Wolf, of the Palace Hotel, used to charge 50c. per night for a chair to sleep in, in the lobby. I have seen men sleeping on and under the billiard tables in the saloons.

Pneumonia exacted a toll of two or three persons daily, from exposure of miners on coming off shifts, staying out at night, drunkenness, etc. At that altitude, 9000 to 11,000 ft., they only lasted two or three days, after being taken with pneumonia.

One of the largest real-estate firms of Denver had loaned money on the cattle ranch which embraced Cripple Creek. It had been compelled to foreclose and take it over at a cost of $12,000, and felt pretty blue over it. After the discovery of gold, the firm platted the town of Cripple Creek, and was tickled to death in the early days, to sell business lots, 25-ft. front, on Bennett Avenue (the main street) for $25 each. The same lots, later, sold for $5000 to $10,000 each.

The Portland mine, which has always been the best one in the district, was originally a triangular half-acre piece of ground, which happened to have the Anna Lee ore chimney on it. The three owners, then poor men, were soon deeply involved in litigation, conflicts and adverses with adjoining claims. They were tied up by injunction, even from taking out any ores, and engaged the services of one of the best mining attorneys in Colorado.

In order to keep him supplied with the sinews of war to fight their suits with, while the injunction was on,

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they would, at night, take out of this Anna Lee chimney a few sacks of the richest ore, worth dollars per pound, pack it off the hill on their backs down to a team and wagon, load it on and one of them drive to Pueblo with it and sell to the smeltery there. Eventually they won out, making a great property. The company has paid over three times its capitalization in dividends, and the end is not yet.

One warm spring day in '97, the Hollingsworth brothers, mentioned above, were sitting on the sidewalk on Bennett Avenue, when Mr. Stratton—who discovered the Independence mine, took out four million and then sold it for $10,000,000—came along; he looked sharply at them as he passed, then turning, came back. When opposite he stopped and asked, "Are you boys the Hollingsworth brothers?" "Yes." "Used to be in the San Juan?" "Yes." "Used to run a burro train packing ore?" "Yes." "Do you remember an old prospector coming along to your camp one night, late, with his blankets on his back, tired and hungry? You took him in, fed him and in the morning when he left you gave him a $5 bill and sent him on his way rejoicing?" "Well, possibly we might have been guilty of that." "Boys, I am that prospector and I want to pay that bill." He stepped into a saloon near-by, called for a pen and ink, and wrote a check for a thousand dollars and gave it to them.

The world has never seen, and possibly never will again see another Cripple Creek, nor an area the size of Cripple Creek's producing district that equals it—with a $250,000,000 production and still producing more than $1,000,000 gold per month.

## Radcliff's Process for Radium Ores

Sidney Radcliff, of Bairnsdale, Victoria, Australia, has recently patented (U. S. pat. 1,049,145) a process for treating complex radium ores. His process contemplates the recovery of: (1) Radium as mixed sulphate of barium and radium; (2) uranium, as oxide or uranate; (3) acid earths, such as tantalum, niobium, or titanium, as oxides; (4) the rare earths, cerium, lanthanum, didymium, etc., as oxides.

The crushed ore or concentrate, crushed to 30- or 40-mesh, is fused in a reverberatory with 2½ times its weight of acid sodium sulphate, and while fluid, sodium chloride, 10 to 15% the weight of the ore, is added and well rabbled in. This reacts with the acid sulphate, bringing about an oxidation of ferrous to ferric sulphate, a more complete decomposition of the ore, and a highly liquid melt. (Other alkaline salts, which will produce the same result, as nitrate of chlorate, are also specified.)

The fused product is then tapped out, cooled, crushed and agitated with warm water. This causes the uranium, iron, aluminum, rare earths and part of the niobium, titanium and tantalum (acid earths) to go into solution. The radium, as sulphate, remains in suspension with sulphates of lime, lead and barium, and fine gangue.

The turbid liquid is then siphoned into settlers, and the coarse residue in the leaching vat washed by agitation and discarded, the washings also going to the settlers. The contents of the settlers are then filtered.

To the solution, containing metals, as shown above, sodium carbonate is added, avoiding excess. The metals precipitate as insoluble carbonates, and are removed by filtration, the liquid going to waste. The precipitate is boiled with an excess of sodium-carbonate solution, which causes the uranium to go into solution. It is then recovered as sodium uranate by the addition of sulphuric acid or caustic soda.

The remainder of the precipitate is treated with dilute sulphuric acid, which dissolves said precipitate with the exception of the "acid earths," which are filtered off and ignited. The sulphuric-acid filtrate is then treated with oxalic acid, the precipitated oxalates washed, dried and ignited. These gives oxides of the rare basic earths.

The fine slimes from the settlers contain most of the radium and are treated in the ordinary way for recovery of radium-barium sulphates. The method is claimed to give a great saving of sodium carbonate over the customary methods.

## Quartz Industry in 1912

Indications are that the production of quartz in 1912 will at least equal that of previous years. New uses are being found for this mineral yearly, resulting in an increased demand. Owing to the abundance and wide distribution of the quartz deposits, however, prices were not affected and $1.25 to $2 per ton would represent the range for the crude material. Quartz of inferior quality, such as the soft, decomposed mineral of certain Western deposits, however, would command a price much below the minimum given.

The prices for ground quartz are dependent upon quality and vary from $4 to $60 per ton. The quality is influenced not only by its chemical purity, but by its form. The highest prices are obtained for the crystalline mineral, which, when ground to impalpability, still retains its angularity. Ground quartz of this character is used in wood fillers, in primer and as an inert base in high-grade house paints to increase the durability. The increase in durability of paint by the addition of quartz is due to the fact that the particles of the latter, by reason of their angularity, form a firm bond between the pigments and the fiber of the wood.

Because the silica is not affected by intense heat, nor subject to undue expansion or contraction, it is being used by dentists in a mixture with plaster of paris as an investing material for inlays. Quartz is still largely used in the manufacture of pottery, both as a constituent of the body to diminish shrinkage and as a glaze, also in the manufacture of scouring soap and powder. It is also used for roofing, for chicken grit, as a flux and as an abrasive. The states producing ground quartz are: Connecticut, Massachusetts, New York, Pennsylvania, Maryland, Tennessee, Michigan and Wisconsin.

## Mine Fatalities in Arizona

The first annual report of G. H. Bolin, state mine inspector of Arizona, has been rendered to Governor Hunt. Mr. Bolin took office May 20, and his report covers the period up to Nov. 30. There were, according to the El Paso *Herald*, 79 operating mines in Arizona, employing 12,000 men, during that period. The fatalities numbered 29 and the injuries 20. Eleven of the men killed were Ray Consolidated employees; the second largest sufferer was the Calumet & Arizona, with four killed; while the Copper Queen and the Arizona Copper had two fatalities each.

# The Igneous Concentration of Zinc Ores

By F. L. Clerc*

*SYNOPSIS—As it costs only one-third as much to put zinc ore through an oxide furnace as it does through a spelter furnace, the oxide process recommends itself as a cheap means of concentration. A study of the conditions under which zinc oxidizes or reduces and a suggestion as to a working concentrating furnace.*

In an earlier number of the Journal[1], I have called attention to the fact that it costs fully three times as much to put a ton of ore through a spelter furnace as it does to put it through an oxide furnace. On this showing, igneous concentration has a claim to consideration if the zinc in three tons of ore can be put into one ton of concentrate before it goes to the spelter works. I have drawn my illustrations of the fire-concentration of zinc from three well known processes of paint manufacture, and have shown in what particulars the apparatus, common to all of them, for collecting their product, should be modified to adapt it to the cheaper collection of a rich concentrate. This apparatus consists essentially of gas flues or pipes, settling chambers, and a straining surface of woven fabrics, served by pressure and exhaust fans. I have shown how the bag surface required may be diminished by facilitating the settling of the fume before it reaches the bags.

## Existing Paint Furnaces Not Adapted to Concentration

These paint furnaces serve well as illustrations, because they are in operation and have been fully described. But none of them is well adapted to cheap fire concentration. Another set of furnaces should be studied in this connection, namely, those which have been proposed or tried for the direct production of metallic zinc by the combustion of fuel mixed with the ore. None of these furnaces was successful, so that what can be learned from their failure must be from accounts of them which have been published. Such records are voluminous and more or less accessible. Fortunately it is not the apparatus employed that will repay study, but rather a summary of their results, and criticisms of them, and of the experiments upon which their theory was based, that throw light on the behavior of zinc in a furnace with blast. For the present purpose two examples will serve, the proposal of Adrien Muller and A. Lencauchez, in 1860; and that of Walther Hempel, in 1893. Both are critically analyzed by Lodin[2] and references given to numerous patents. What is of greater present interest in connection with the former, may be found in a paper by M. Lencauchez,[3] in which he explains his connection with the enterprise, and records some experiments made before and after its inception.

Such of his conclusions as have been verified are now generally known, and were known at the date of this publication, but at the date of his patent they were not to be found in textbooks; but, however well known, these facts are often lost sight of, and a review of his 10 paragraphs will serve as an introduction to the subject.

## Tension of Zinc Vapor

Metallic zinc was exposed to a welding heat, in a tightly plugged Belgian retort. The retort was not broken, although the escape of vapor through the retort was slight. Whence, he reasons, under a pressure of two or three atmospheres, zinc would be a liquid at the temperature of reduction by carbon. Later measurements have corroborated this conclusion for undiluted zinc vapor. But if zinc is mixed with other gas, it sustains only a part of the total pressure, thus if it bears only one-fifth of the pressure, the same reasoning would show that a total pressure of 10 or 15 atmospheres would be required to keep it liquid.

A current of carbon dioxide, passed over metallic zinc heated white hot in a porcelain tube, completely oxidized it. A current of carbon monoxide passed over zinc oxide heated in the same way reduced it completely, but the zinc was again oxidized in a cooler portion of the same tube, by the carbon dioxide formed by the first reaction. The end result was simply the transfer of zinc oxide from one place to another. More recent studies have shown in what respect, these reactions of carbon monoxide and dioxide are modified by the temperature and volume of the gas current in either case. But as neither pure carbon dioxide nor carbon monoxide are at the disposal of the furnace man, the exact conditions of equilibrium need not here be considered.

Lencauchez observes that blue powder is produced in all systems of zinc smelting and believes that it is unavoidable, and that it is, in the main, metallic zinc superficially coated with 4 to 8% of zinc oxide. He records that a pure blue powder, containing 95% metallic zinc and 5% of zinc oxide, can be obtained, by passing a current of otherwise neutral gas, containing 5% to 6% of $CO_2$ over zinc vaporized in a porcelain tube. Also that blue powder under a lens looks like bird shot, which has been dusted with meal while wet. It will volatilize without melting, if heated without compression, because its grains are so small, and the oxide is so light that molecular approach is impossible. The oxide acts like a sponge, but if this sponge is squeezed, the melted zinc runs freely from it, as water runs from a sponge on the slightest pressure. It appears then, that he means that a slight insulation of zinc oxide will prevent the particles of blue powder from uniting at a temperature at which they are liquid. Commercial blue powder varies greatly in composition, and oxidizes rapidly under atmospheric conditions, which facts he fully realizes.

Gas having the following composition by volume: N, 59%; $CO_2$, 12; CO, 24; hydrocarbons, 2; H, 3%, was drawn from a blast furnace, through a porcelain tube heated white hot, and thence into a similar tube containing zinc oxide heated to a high temperature. The zinc oxide was rapidly reduced and the issuing gases contained about the same amount of $CO_2$ as of CO.

Sulphide of zinc mixed with carbon may be reduced and volatilized in a retort or crucible, but since the bisulphide of carbon formed by the reduction, will at a

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[1]Eng. and Min. Journ., Jan. 13, 1912.

[2]"Encyc. Chimique." M. Fremy. Tome V, 2e. Sec., 2e. Partie. Metallurgie du Zinc, par A. Lodin.

[3]Moniteur Industriel du Belge, Oct. 20, 1877.

lower temperature react with the zinc, the end result will be the transfer of zinc sulphide from one place to another. He thinks that zinc sulphides might thus be separated from the sulphides of other metals which are fusible in a reducing atmosphere (and so would remain behind under a cover of slag), if a proper flux were added; and notes that by burning the zinc vapor and bisulphide of carbon as they issue from the crucible, they can be completely oxidized to ZnO and $CO_2$, and that the former might be sold as a common paint, or reduced in ordinary furnaces to metallic zinc. He apparently believes the same result would follow heating the same mixture in a cupola furnace (*cubilot*), which seems to imply the use of a blast.

### Difficult to Test Effect of CO Free from $CO_2$

Attempting to produce blast-furnace gas free from $CO_2$, a vertical tube of fire clay, 12 ft. long with an internal diameter of 8 in., was set over a fireplace 16 in. square and 24 in. deep, and was inclosed in a vertical furnace so constructed that the flames passed up one side of the tube and down on the other on their way to a stack 33⅓ ft. high. The tube was thus brought to a welding white heat throughout 10 ft. of its length; the thickness of its walls was 0.8 in.

A ½-in. iron pipe, passing through a hole in the bottom of the tube delivered air, previously heated to 400° C. in a Belleville boiler, converted into a hot-blast stove. To insure a thoroughly dry and hot charge for this experiment, a mixture of oven coke and charcoal was brought to a cherry-red heat in a separate box, and charged hot from this box to the inner tube. The gas issuing from this producer so constructed, heated, charged and blown, contained 0.05% of $CO_2$. He reasons that it has passed through a bed of coal 10 ft. thick, held at a temperature of 1600° C. This may well be doubted, for if the fuel charge contracted at the higher temperature, an easier passage would be found for the blast, next the wall, and this opening would be enlarged by more rapid combustion there. In the light of modern practice, it is probable that an equally good gas, could be much more readily and cheaply made in a differently proportioned insulated shaft, heated by combustion within itself. Gas containing even 0.05% of $CO_2$, if passed over boiling zinc will produce some blue powder, and issue completely reduced, as he proved by a special experiment.

In testing the effect of rapid cooling of mixed gases containing zinc vapor, he reasons that at the temperature of 300° C., zinc is solid and but slightly acted upon by $CO_2$, therefore if the gases containing zinc drawn from the furnace at 1200°, are cooled rapidly enough to this temperature, the time would be too short for much oxidation to take place. And he built a little furnace 5 ft. high, 14 in. square. This furnace was blown with a blacksmith's bellows, and was equipped with a condenser, consisting of a single tube with internal diameter of 1.6 in., and 10 ft. long. This tube was wrapped in tow held in place by rags, and bound with wire, and was kept under a constant shower of cold water.

The furnace was charged with calamine (such as was used in near-by zinc works) mixed with charcoal. He obtained in the condenser of this primitive apparatus 90% of the assay of the zinc, in the form of blue powder, and only rarely found a metallic particle the size of a grain of wheat. His proposal to realize on a commercial scale this rapid cooling need not concern us, since it involves a cooling of pipes, by water circulating around them, from 1200° C. to 300° in one-third of a second, for which purpose he devises a relay of condensers, brought up in succession to an aperture in the furnace walls, which are to be filled in order in 10 or 15 min., and as often renewed. With a set of four condensers, three could be scraped out while the fourth was filling.

The subsequent treatment of the blue powder still has some interest. Compressed into bars 8 in. long by 2.8 sq.in. and heated in a crucible to 460°, metallic zinc is seen to sweat out of the bar and run together into the bottom of the crucible. The residue, while shrinking in all dimensions and sometimes breaking into several pieces, retains the general shape of the bar, and contains nearly all of the impurities originally in the blue powder, while the liquated zinc is much purer than from blue powder compressed during fusion as in the Montefiore furnace; in fact is as pure as redistillation would make it.

Lencauchez's last conclusion may be quoted more at length: (1) A shaft furnace for zinc would be called for, only if a supply of ores could be regularly purchased at $2 to $3 per ton, from which 6 to 10% of zinc could be obtained by distillation and from 25 to 35% of pig iron could be collected in the hearth. Without that amount of iron the hearth would be choked with slag. (2) Intimate mixtures of sulphides of zinc and lead can be smelted in a cupola furnace, and the zinc collected in settling chambers and gas washers (his inference that melted sulphide of lead would remain in the furnace is unwarranted). (3) Blue powder produced by all systems of smelting zinc ores, can be profitably compressed and purified by simple fusion, so as to give a cast product of as good quality as distilled zinc.

### Hempel's Zinc Ore Treatment

Passing over a third of a century brings us to the proposal of Walther Hempel. I have not read the original paper, but infer from extracts that his experiments were on a small scale, as they are said to have been carried on in a furnace of the Sefstrom type. This is essentially a composite crucible having a metallic shell and a refractory lining, with holes at the bottom for the admission of a blast, and covered or not as may be desired. In this case the material treated appears to have been introduced directly into the furnace and not inclosed in an interior crucible heated by surrounding fuel. The blast was heated in iron pipes. The charge consisted of "zinc coke."

This zinc coke was made from a mixture of three parts of coal, one part of zinc oxide and 0.05 part of caustic lime, molded into briquettes, and coked in a retort. The gases from the furnace were carried off through an iron tube, in which they were cooled to 86° F., and drawn through a centrifugal separator. This separator consisted in a rapidly revolving fan, inclosed within two housings. The particles of fume, thrown against the walls and vanes of the inner casing, fell into the space between the two casings, and were drawn out through spouts below. The gases passing through the fan were filtered through a bag.

In heating up the furnace, before zinc coke was charged, the proportion of $CO_2$ in the issuing gases was reduced to 0.7%, and during three hours of distillation it ranged between 1.8% and 4%. The gases freed from zinc are es-

[1]Berg. und Hutten. Zeit., Oct. 13, Oct. 20, 1893.

sentially carbon monoxide and nitrogen and are valuable for heating purposes. The zinc fume produced contained from 72% to 90% of the zinc in the ore. This fume was compressed into ingots, and distilled in a retort without the addition of carbon and yielded 66% of its weight in metallic zinc. When argentiferous lead was added to the charge practically all of the lead and silver went off with the fume, and most of it was contained in the residue from the redistillation of the zinc.[5]

### Experimenters Failed to Note Concentration Possibilities

Failing to produce liquid zinc in a furnace modeled after an iron-blast furnace, Lencauchez hoped to obtain a metallic fume, which by simple melting would yield a refined zinc. Hempel added a mechanical device, hoping to facilitate the collection of this metallic fume, and proposed to distill it at a lower temperature than is required to reduce zinc oxide. Both of them recognized how easy it is to produce a rich concentrate of sublimed oxidized zinc in a blast furnace, as has been the case of many experimenters before and after them. But their object was to produce metallic zinc direct from the ore and to get rid for all time, of the cumbersome distillation in small fragile retorts. Failing in this object, it is natural that they should overlook the importance of this discovery, and should make no adequate effort to develop it.

The discoverers and early explorers of the New World were in search of China and the Indies, and for nearly two centuries afterward their efforts were mainly directed to finding an easy passage thither. Access to these goals is now across a developed continent. Experiments in the electro-thermic smelting of zinc show that investigators are still following the old charts. I believe that the first effective step toward discarding the petty alembics and other alchemistic paraphernalia and traditions, which characterize zinc metallurgy, will be taken when the importance of the proper preparation of the charge to be distilled is fully realized. Then the *caput mortuum* of broken, corroded and zinc-saturated retorts, will no longer be an inexplicable remainder, and the transmutation of gold or silver into zinc, will be an art, rather than a guild mystery, and this transmutation will be found reversible, gold and silver can be made in zinc smelting.

### Two Stages Not Always Combinable

Lencauchez argued because zinc and bisulphide of carbon were distilled, when zinc sulphide and coal were heated together in a retort, and the burning of this distillate produced zinc oxide and sulphurous oxide, that, therefore an excess of air blown through the same mixture would give the same final products. But the presence of air in the charge must profoundly affect the reactions which occur in the furnace. And the presence of slag- and matte-forming materials, in the charge, may seriously interfere with the expulsion of the zinc. In this connection the following experiment made in 1875 has some interest.

The furnace used was not a regular oxide furnace. It was in fact the fireplace of a small double-hearth reverberatory calcining furnace, in a spelter works. The two hearths were arranged, one over the other, the lower hearth was separated from the fireplace by a bridge wall, the upper hearth connected by a short flue above its arch, with a low chimney built up from the end wall of the furnace, and a blast of slight pressure from a fan, was supplied under the grate. The gratebars of the fireplace were the regular perforated cast-iron bars used in the oxide works, and the ashpit and ashpit doors were similar to those of an oxide furnace. Taken by itself the fireplace of this calcining furnace was practically a small Wetherill oxide furnace. The products of combustion were allowed to pass over the bridge and through both hearths, but the flue to the chimney was stopped, and their escape was through a door at the end of the upper hearth. An old bag from the oxide works was fastened closely around the frame of the open door. This bag was about 25 ft. long and 2 ft. in diameter, it was suspended horizontally by cords from the roof of the furnace building, and its outer end was tied. The blast pressure was sufficient to distend the bag, and was not to be distinguished from that used in the oxide works.

### About 4% Zn Left in the Cinder

The unroasted ore, mixed with about 40% of its weight of anthracite, was crushed to pass a ¼-in. screen. The furnace was run in the regular way, exactly as in the process for making zinc white from oxidized or roasted ores. But it was noticed that it took longer to work off the zinc, and that the furnace ran hotter. No escape of solid fume through the bag was detected. The fume collected from the bag at the end of the operation, was decidedly reddish in color, it was light and feathery, and could not be handled without rising in the air; and it overflowed any receptacle in which an attempt was made to compress it. Practically all of the sulphur it contained was oxidized, and was expelled by a moderate heat. The object of this experiment was to determine how clean a cinder could be made when treating unroasted lean blendes in an oxide furnace. No attempt was made to sample the fume, or to determine the percentage of yield. Samples of the cinder from all parts of the grate were analyzed for zinc. In the thin, better fused portions, 4% of zinc was found. Thicker partially fused crusts, against the walls and around blowholes in the bed, contained 10 to 12% of zinc. Similar differences can be found in samples of cinder taken from corresponding places in ordinary oxide making.

The ore used in this experiment was a mixture of calcareous and pyritic blendes, which were separated by hand picking at the mines, neither of them contained visible amounts of carbonate or silicate of zinc. As charged they contained about 40% of ZnS, 30% $FeS_2$ and 30% of very siliceous dolomite. I do not know of another instance in which raw blende, unmixed with oxidized ores, has been treated in an oxide furnace. It was the regular practice to make an inferior paint from blende, heap roasted, or roasted in reverberatory kilns. This heap roasting was practiced for many years and these outdoor kilns contained from 50 to 100 tons of ore. In every case where I have heard of oxide of zinc being made from blende, I have learned that the blende had been previously roasted.

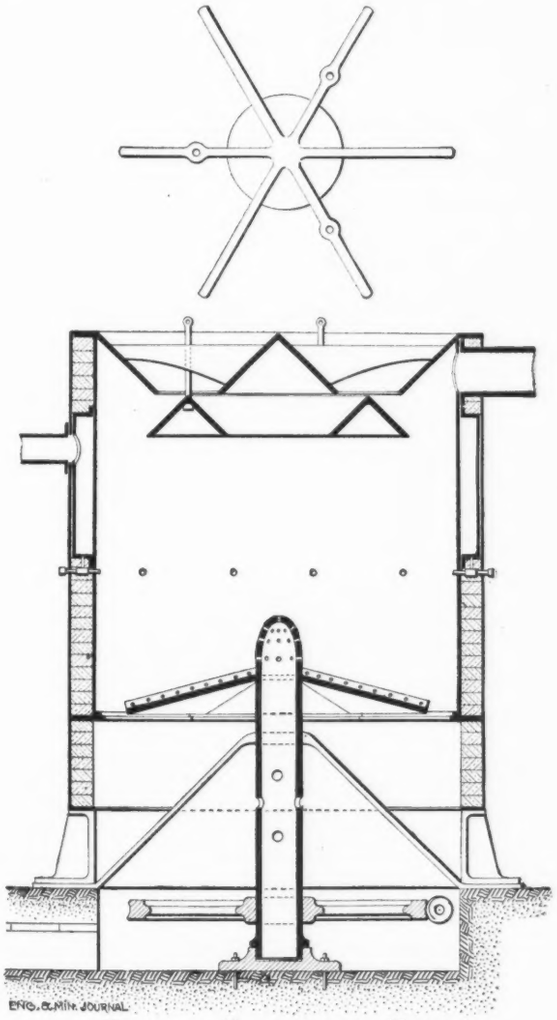
### Difficulties of Igneous Concentration

Blast-furnace processes having failed to produce liquid zinc, it remains to consider them in connection with igneous concentration. In the processes I have chosen, the defects from this standpoint are apparent. They involve the separation of a valuable pyrophorous fume from

[5] "Hand Book of Metallurgy," Schnabel, and "Metallurgy of Zinc." W. R. Ingalls.

a great volume of hot, poisonous, and explosive gas mixture.

To state the fact is to expose the difficulty. As compared with the rapid oxidizing paint-producing processes, they have, however, certain advantages, in their continuous operation, in their economy of fuel, and in the great variety of ores which can be treated by them. The modifications required to adapt them to fire concentration, readily suggest themselves. The gaseous products should be oxidized as completely as possible in that region in the furnace where the heat generated will do the most good, and as much as possible of the heat generated by burning them elsewhere, should be returned to the furnace in a heated blast. Confining myself to the treatment of ores




PROPOSED SUBLIMATION KILN

whose value is chiefly in zinc, and to that class of ores in which the zinc can be expelled by heat without melting the residues into a fluid slag, I submit the following modification (not patented) of the well known Taylor revolving-bottom gas producer, as a tentative design, for a continuous-sintering sublimation kiln, to oxidize all combustible matter and expel all volatile matter from a charge whose residuum does not melt freely at the temperature required. The diagram shows a section through the axis of the kiln, an annular bell to distribute the charge, an air jacket to heat the upper blast, upper tuyeres, sliding through sleeves in branch "tees," which are easily replaced, and act as stop-cocks, when given a quarter turn; a removable cap at the outer end of the tuyere permits temperature observations, or the insertion of a rod. The deck of the revolving bottom is made heavy, on account of the heavy clinker, and opposite its periphery, a hexagonal or octagonal breaking plate is set in the wall of the furnace, to assist in breaking up tough clinker passing between it and the edge of the sloping deck. The fixed cone below the deck protects the driving mechanism, gives additional support to the turning column, and discharges the clinker under the lower edge of the kiln walls, where it serves as a sufficient seal against the blast as it does in the Gjers continuous kiln.

A uniform distribution of the charge is essential to the regular working of the kiln. The functions of a kiln and a gas producer are radically different, while the apparatus employed may be the same, its operation as a kiln is not the same as when it is used to produce fuel gas. Hence, for a kiln an upper heated blast is used where the greatest heat is needed. The lower cold blast will be heated by passing through the hot clinker, before it reaches combustible material. It should be sufficient in amount to gasify the fuel, and to reduce and expel the volatile matter in the charge. The upper heated blast should be just sufficient fully to oxidize these products of partial combustion and distillation. The behavior of zinc gas in such a kiln may well be considered. In the shallow charge, five to six inches deep, on the grate of an oxide furnace, there must be a wide range of temperature, cold air after passing through the ash pit and the holes in the grate bars, meets a thin bed of partly burned coal, and next to it, the mixed bed of ore and coal, in which sufficient heat is generated to reduce and volatilize the zinc and sinter the slag. The zinc gas and partly burned coal gas must burn at or above the top of the charge, by the excess of air coming through the grate bars. Some of the heat so generated is intercepted by the arched top of the furnace and radiated down onto the charge, but much of it must be wasted in the flues. The blast is in sufficient amount to chill the bottom of the clinker on the gratebars, and prevent it from running through into the ash pit. Some idea of the behavior of zinc gas in a thicker charge may be inferred from the behavior of the loosely held atom of sulphur in $FeS_2$ in pyritic smelting. This atom of sulphur is expelled at a low heat, consequently it escapes near the top of the furnace, where little free oxygen is present, and moreover, where the heat generated by burning it cannot be utilized. With the object of utilizing this heat, special methods of introducing the charge have been devised to carry the unaltered $FeS_2$ lower down in the furnace.

The reduction of zinc oxide and the volatilization of the zinc can only occur at points where a temperature of more than 1000° C. is attained, consequently lower down in the furnace than where sulphur is disengaged from $FeS_2$. It is therefore reasonable to suppose that some of the heat generated by burning it, can be utilized to heat the descending charge. The zinc gas will prevent the coal from burning, as long as there is not an excess of oxygen present, in the way that sulphur fumes will put out a fire. If, however, the top of the kiln becomes too hot, and the products of combustion have to pass through too thick a bed of charge containing carbon, the carbon dioxide may pick up carbon according to the reaction $CO_2 + C = 2CO$, and in addition to wasting

fuel, will carry a dangerous gas, carbon monoxide, into the bag room. In effect a gas producer will have been superposed on top of the kiln.

It will be necessary in any case to insure complete oxidation, by introducing additional air into a brick or lined flue, where the gases can burn after leaving the kiln. It is sometimes advisable to use water in the ash pit of a gas producer, or to blow it with a steam jet; both practices are objectionable in a subliming kiln. The moisture contained in the charge will not be sufficient in amount to cause serious trouble. It is probable that a considerable percentage of blende mixed with oxidized ores, could be treated in this kiln without much interfering with its regular work, and that to some extent sulphides could be substituted for carbonaceous matter as the fuel.

### Working a Subliming Kiln

The charge for this kiln should be a mixture of coal and ore, as in the Wetherill oxide furnace. Probably much less coal will be required, and it may be of inferior quality, and probably it need not be so finely crushed. It is an easy matter to use insufficient coal, so that the kiln will run too cold. It should be equally easy to avoid an excess, causing it to run much too hot. The rate of combustion can be greatly influenced by regulating the blast, while determining the proper constitution of the charge. The fusibility of the gangue, and the ash of the fuel determines to some extent whether ores can be sintered to sublime off the zinc. But much also depends on the length of time they are exposed to the high temperature required, and on the rapidity with which they are afterward cooled. The residue produced in an oxide furnace treating franklinite, strikingly illustrated this fact. Ores which are excessively siliceous or excessively basic, are comparatively infusible. But the latter may become more fusible in proportion as the zinc is driven out. I have excluded from consideration those ores, the residues of which should be melted into a fluid slag or matte, in order to free the zinc, for the reason that in the case of such ores, the recovery of some other metal is generally more important than the recovery of the zinc. And in such cases, the furnace and process should be adopted to saving the greater value. But when sublimed zinc oxide has a recognized market value in spelter making, it may be expected that it will be produced and collected in other smelting operations. From the standpoint of existing zinc companies, it is natural they should not eagerly welcome any innovation which involves a radical change in their methods of buying, sampling and shipping their raw material, as a consequence of its higher zinc contents, and may disturb the equilibrium established between the departments at their works, and require some changes in the dimensions of their furnaces, and in the organization of their working force. Back of feeling is the doubt whether the new conditions will prove permanent. But all improvement is to some extent innovation, and even the most conservative industries show some improvement with each succeeding decade. If igneous concentration of zinc becomes an established industry it must result from one or other of two alternatives, either the ore producer must take up another branch of metallurgy in addition to the mechanical preparation of his ores, and become something of a furnace man, or the smelter must accept leaner ores from the miner, and thus relieve him of some of the work involved in bring them up to present standards.

## Rutile Production in 1912

In 1912, the only American producer of rutile, according to the U. S. Geological Survey, was the American Rutile Co. At its mine and mill at Roseland, Nelson County, Va., this company produced 275 tons of concentrates carrying from 80 to 85% of titanic oxide.

The company works ore of two sorts, phases of the same rock mass. One phase is composed mostly of feldspar, quartz, and rutile. The other contains considerable hornblende and ilmenite, besides the constituents named. From the first phase a light red rutile, free from iron, is obtained, which concentrates to more than 94% of titanic oxide. The rutile obtained from the other phase of the rock is somewhat darker colored than that from the first phase.

The ilmenite is easily separated from the rutile by an electromagnet and 100 tons of such purified concentrate were produced which carried 94% or more of titanic oxide. The separated material carries from 50 to 60% of titanic oxide and as much as 42.3% of iron oxide. It is especially adapted for making ferrotitanium.

The company allowed its plant to remain idle during 1911 and did not begin operations in 1912 until June. During the year a Wetherill magnetic separator was put into operation and a pulverizer was added.

The company's product is sold for making ferrotitanium for use in the manufacture of steel, in electrodes of the "magnetite" arc lamp, in the ceramic trade, and in dyeing leather and textiles. Prices range from $30 to $160 per ton, according to percentage of titanic oxide and quantity. Pulverized rutile and extra pure grades sell for higher prices.

Some prospecting for rutile was done at Magnet Cove, Ark., in 1912, but no production was reported.

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## Graphite in 1912

The production of natural graphite in the United States was about normal in 1912, amounting to a little less than 4000 tons. The principal production was from New York and Alabama. The American mine of the Joseph Dixon Crucible Co., at Graphite, near Ticonderoga, N. Y., was as heretofore the leading producer both in quantity and quality. There was a small production in Pennsylvania, and a number of other states produced amorphous graphite and graphitic shale, the normal production being about 1200 to 1500 tons. Prices stiffened toward the latter end of 1912, probably due to the better general outlook throughout the country. American crystalline graphite closed at 5 to 8c. per lb. in carload lots, at the mine. Lower grades, as usual, could be bought down to 1c. per lb., or even as low as $15 per ton for an impure product containing about 33% C. The highest grade of Ceylon graphite was quoted at the end of the year at 9c. per lb., ranging down according to quality to as low as 1½ and 2c. for impure grades. From 12,000 to 15,000 long tons are imported annually from Ceylon. Our total imports, however, often reach 20,000 tons, some of which comes from Austria and Canada. The Canadian production is mainly from Quebec.

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**A Deposit of Radium Ore** is reported to have been discovered near the Salzburger Kopf, Germany (Chem. Tr. Journ., Dec. 7, 1912). The land, which on receipt of the news rose about seven times in value, has been acquired by a firm for exploitation.

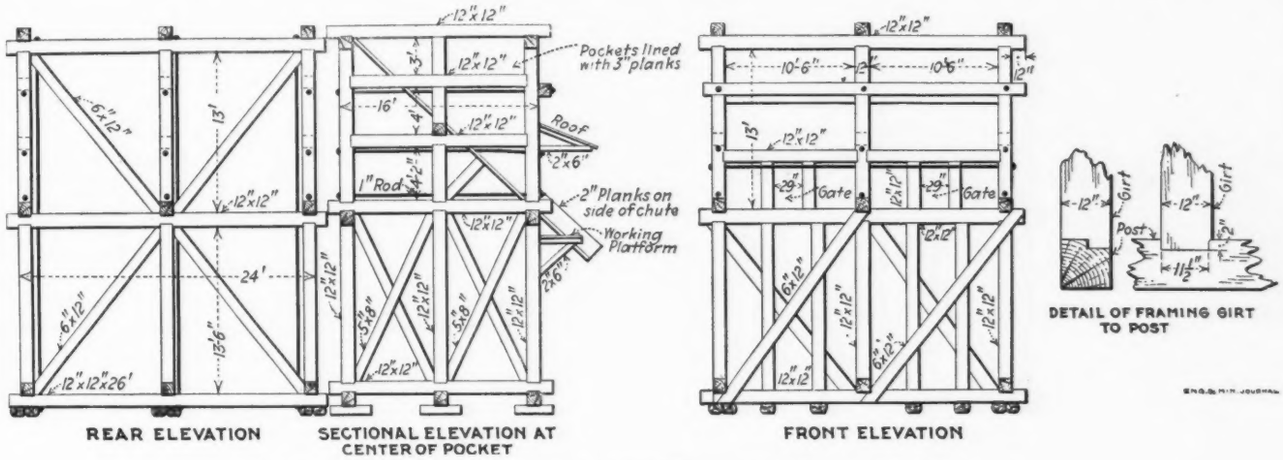
# DETAILS OF PRACTICAL MINING

## A Timber Ore Pocket

By H. L. Botsford*

In the design of a timber ore pocket, such as is shown in the accompanying drawing, due consideration must be given to the severe conditions to which the timber is subjected. Pockets are not usually covered, but are left entirely exposed to the weather, and the ore itself often contains much water. For these reasons, the timbers are subject to rapid decay.

In pockets which have been in use for several years, it is seen that failure begins by the crushing of the front posts into the sill or into the intermediate cap above. The crushing strength of timber across the grain is much diminished by the presence of moisture in the wood. It is advisable to use timbers of larger size than those demanded for mere strength, as the life of the pocket will be much increased. Treating the timbers with a wood preservative is also advisable.




A Timber Ore Pocket Designed to Withstand Severe Conditions

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## Rogers Mine, Iron River, Mich.

Negaunee Correspondence.

The new steel shaft house at the Rogers mine, in the Iron River district, has been completed. The construction is different from that at many of the mines in the district, in that after the ore is dumped from the skip it goes down through gyratory crusher and ore pocket without any secondary hoisting. This is similar to copper-country practice where the jaw crushers are set high, so that all the hoisting may be accomplished at one time, even though the jarring effect on the steel structures is harmful.

Many of the mines in the Iron River district place the crusher on a concrete foundation close to the ground, then hoist the crushed ore up an incline to the ore pocket, where it is loaded into railroad cars. This permits using a low headframe and gives the crusher a secure foundation; on the other hand, it requires an extra man to run the secondary hoist and load the secondary skip (usually one man does both), and adds extra cost due to handling the ore twice. The Oliver Iron Mining Co. crushes most of its Menominee range ore at a crushing plant at the ore docks at Escanaba, thus doing away with crushers at the mines and centralizing the process.

On the Marquette range, the Cleveland-Cliffs Iron Mining Co. practices secondary hoisting at the Cliffs hard ore shafts in Ishpeming, where one crusher midway between serves two shafts; at the company's South Jackson property, an opencut mine in Negaunee, the ore is hoisted to a crusher at the railroad track, being handled twice.

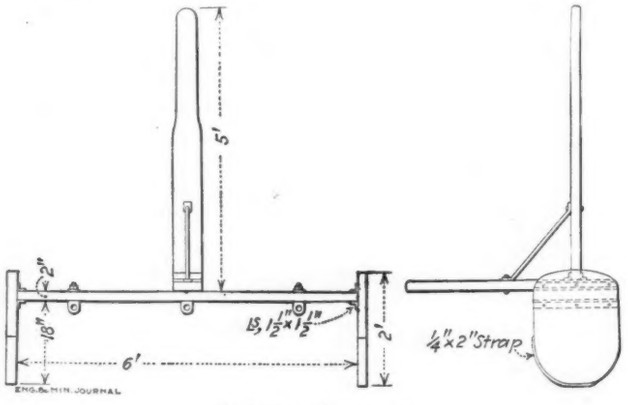
At the Rogers mine, the headframe and crusher plant, with ore bins, are erected as one structure, 140 ft. high over all. The center of the sheaves is 118 ft. above the collar of the shaft. The crusher, a No. 8 McCully, is set on a platform 52 ft. above the shaft collar, and is driven by an electric motor as at the Hiawatha mine of the same company. Ore from the skips is dumped over manganese grizzly bars directly to the crusher. The crusher product discharges into a hopper, and from this into one of three chutes branching off from it, each of which feeds corresponding compartments in the storage bins, the object being to separate three grades of ore. There is also a fourth chute lower down for lean ore to be handled in stock-pile cars. Such ore can also be hoisted separately, if desirable, in cars carried on the cage. The crusher-plant and auxiliaries are completely inclosed by corrugated-iron sheathing. One of the convenient features is the method of handling the sheave wheels and heavy crusher parts, the former by revolving jib cranes and the latter by 15-ton trolleys on an I-beam.

*Mining engineer, Creighton Mine, Ontario.

The entire equipment of the mine is designed with the idea of permanency which the large orebody makes possible, and with the knowledge that the mine is rather isolated, being four miles from Iron River. Thus, the change house is provided with a hospital room and emergency outfit, where a doctor can treat an injured man without taking him to the hospital in Iron River; the change house also has a laundry where hot and cold water, tubs and soap are furnished men for washing their clothes. The hoists are designed for operating to a depth of 1200 ft., although the orebody as so far blocked out is close to the surface soil. The diamond-drill exploration was stopped when enough ore was proven to warrant a first-class equipment, without trying to estimate the ore on the entire property. Following the usual practice in uptodate installations, the skip hoist is first motion and hoists in balance, while the cage hoist is geared and hoists with the cage balanced by a counterweight. The skip hoist is a Nordberg, 20x20x48; the cage hoist is of Wellman-Seaver-Morgan design, capable of handling a maximum unbalanced load of 13,000 lb., with 135 lb. steam pressure at the throttle; it is equipped with a capable safety device to prevent overwinding.

## A Snow Scraper

The accompanying drawing shows a snow scraper that has been found to work well in the Lake Superior copper country, where heavy snows are encountered. This scraper




A Snow Scraper

is made of 2-in. planks and is 6 ft. wide. On the ends of the scraper plank are shoes, on which the snow scraper rides when its load of snow is being dumped or when traveling from one place to another, and it is not desired to do any scraping. The tail piece that drags behind the scraper keeps it up to its work while in operation, and by means of it the scraper is dumped. In its whole operation this snow scraper resembles the ordinary dirt scraper.

## Field Book Pencil Sharpener

In keeping underground or surface field surveying notes, a sharp pointed pencil is required. Fred J. Horning, of Saginaw, Mich., recommends the following method: On the inside of the back cover of the notebook, near the outer edge, paste a strip of fine emery cloth, or sandpaper, an inch wide by three inches long. The lead dust can be blown off as produced or the soiled fly leaf easily cleaned with an eraser when the notebook is filled.

## Graphic Solution of Compressed Air Transmission Formula

The formula frequently used for computing the economical size of pipe to transmit compressed air is that of D'Arcy, as follows:

$$D = c\sqrt{\frac{d^5\ (p_1 - p_2)}{w_1 l}}$$

Where,

$D$ = The volume of compressed air delivered in cu.ft. per min., at the final pressure;
$c$ = An experimental coefficient determined for the various sizes of pipe;
$d$ = The diameter of the pipe in inches;
$l$ = The length of the pipe in feet;
$p_1$ = The initial gage pressure in lb. per sq.in.;
$p_2$ = The final gage pressure in lb. per sq.in.;
$w_1$ = The density of the air, or the weight in lb. per cu.ft. at the initial pressure, $p_1$.

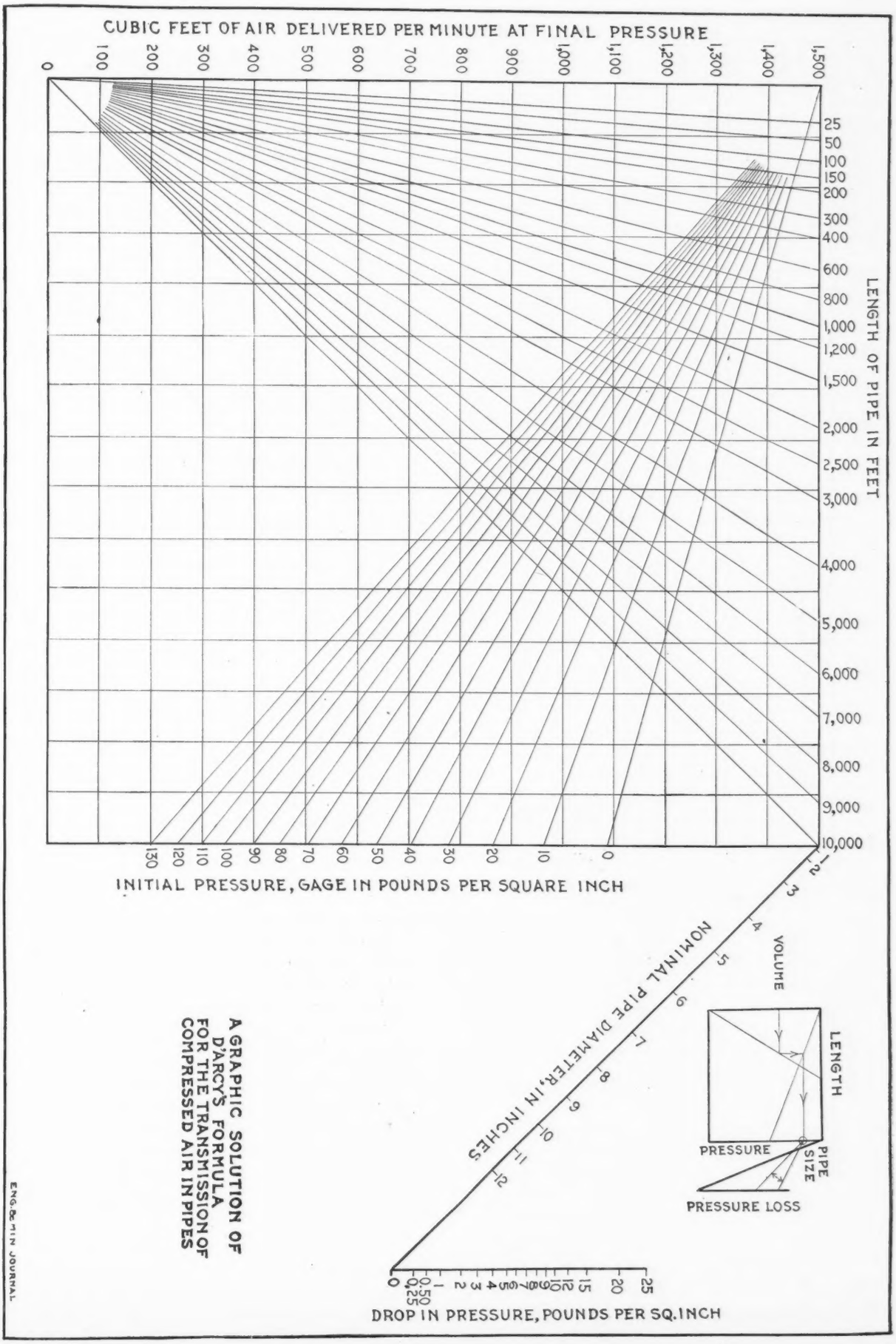
The most common case is that in which the given quantities are: the quantity of air required, the length of the pipe, and the initial pressure. The method of solution is to assume a pressure loss and to compute the remaining factor, $c\sqrt{d^5}$, thus giving the size of pipe corresponding to the assumed loss of pressure. It is always desirable to try two or more pressure drops, in order to find the combination that is most satisfactory, since often a small change in the size of pipe will reduce or increase the loss of pressure several pounds. An alternative method is to assume a size of pipe and calculate the corresponding pressure drop. Each method involves a series of tedious calculations to arrive at the most economical solution, and also requires the use of tables giving the constant, $c$, the actual diameters corresponding to the nominal pipe sizes, the density of the air, $w_1$, and often, for convenience, a table giving the value of the expression

$$\sqrt{\frac{p_1 - p_2}{w_1}}$$

A graphic chart has been constructed for the solution of these problems with no computation, and without the use of tables. The procedure is as follows:

Begin with the quantity of compressed air delivered, on the left-hand vertical scale; follow across horizontally to the intersection with the inclined line corresponding to the length of the pipe line; pass up vertically to the inclined line corresponding to the initial pressure; then cross the chart horizontally to the heavy line at the right of the cross-sectioned part of the chart. The point here found is a pivot point, which is held with a pencil, pen, or needle point, and a straight-edge placed against it and swung across the "Z" diagram. Any two points on the inclined and vertical lines that are cut by the straight-edge at the same time go together as one solution of the problem, giving a pipe diameter with its corresponding loss of pressure. By swinging the straight-edge, it is possible to see at a glance how the final pressure is affected by a variation of 1 in. in the pipe size. Moreover, the size giving the most desirable result is determined at one operation. If the drop is considerable, it

*Excerpt from an article, "A Graphic Solution of D'Arcy's Formula for the Transmission of Compressed-air in Pipes," by Nathaniel Herz, Dec., 1912, Bull. A. I. M. E.


CUBIC FEET OF AIR DELIVERED PER MINUTE AT FINAL PRESSURE
0 100 200 300 400 500 600 700 800 900 1,000 1,100 1,200 1,300 1,400 1,500
LENGTH OF PIPE IN FEET
25 50 100 150 200 300 400 600 800 1,000 1,200 1,500 2,000 2,500 3,000 4,000 5,000 6,000 7,000 8,000 9,000 10,000
130 120 110 100 90 80 70 60 50 40 30 20 10 0
INITIAL PRESSURE, GAGE IN POUNDS PER SQUARE INCH
NOMINAL PIPE DIAMETER, IN INCHES
2 3 4 5 6 7 8 9 10 11 12
VOLUME
LENGTH
PRESSURE
PIPE SIZE
PRESSURE LOSS
0 1/4 1/2 1 2 3 4 5 6 7 8 9 10 12 15 20 25
DROP IN PRESSURE, POUNDS PER SQ. INCH

A GRAPHIC SOLUTION OF D'ARCY'S FORMULA FOR THE TRANSMISSION OF COMPRESSED AIR IN PIPES

ENG. & MIN JOURNAL

may be desirable to adjust the volume to correspond with the new final pressure, and to repeat the operation; but, within ordinary economical limits, the error involved by not doing so is negligible.

Sometimes the problem may arise in another form; for instance, to find the maximum volume that can be handled in an existing line. In this case, the process is reversed. Begin with the maximum desirable drop, and the size of pipe, then pass to the initial-pressure line in a horizontal direction, then vertically to the length line, and finally horizontal to the left-hand scale, which will give the corresponding volume. Any other combination can be solved in a similar manner.

The accuracy of this chart is well within commercial limits. It has been checked against calculated values for combinations varying from 100 to 1000 cu.ft. of compressed air delivered per minute, pressure losses from three to 10 lb., and pipes from 10 to 4000 ft. long; all results were within 0.5 in. of the pipe diameter, and most of them within 0.25 in. or less.

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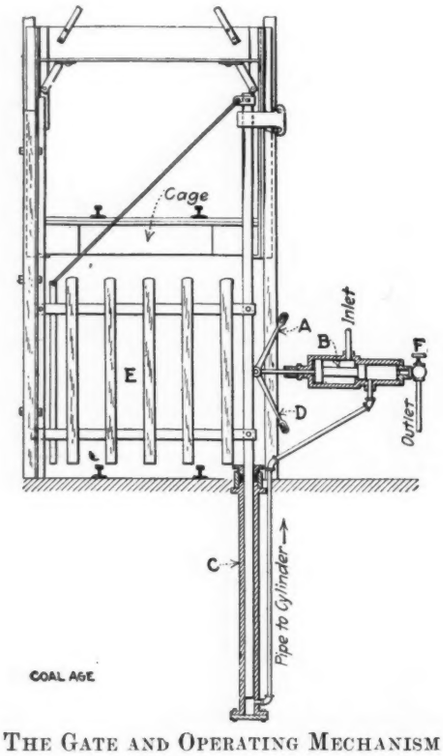
## Harvey Safety Shaft Gate

A recently invented safety gate for mine-shaft collars or stations, while designed for coal mines, is equally applicable in metal mines. It was invented by M. W. Harvey, of Sykesville, Penn., and due to its simplicity and ease of manufacture, requires more than a casual notice, says *Coal Age,* Jan. 18, 1913. It consists of a cylinder approximately 6½ ft. long made of 4½-in. pipe and provided with a stuffing box at the top, inside of which works a plunger made of 4-in. pipe which has been turned down and polished to a diameter of 4⅜ in. outside.




THE GATE AND OPERATING MECHANISM

The cylinder is placed vertically in the ground, which renders it frostproof. It may be set at either side of the gate, to be operated as convenience may dictate. The gate itself may be made by bending two pieces of strap iron and bolting wood palings vertically between them.

A controlling valve, somewhat similar in principle to a piston valve on a steam engine, is provided. This is equipped with a contact for the cage in its proper position for loading. The contact is controlled in its movement by the levers *A* and *D,* the ends of which are slotted and slide on pins as shown. The outlet, or exhaust, is provided with a throttle valve to control the downward movement of the gate. The general arrangement can be clearly seen in the accompanying drawing.

The operation is as follows: When the cage is brought to position for loading from the ground, it makes contact as just explained and operates the piston valve *B.* This admits air or steam to the vertical cylinder *C,* forcing up the plunger and with it the gate *E.* When the cage is moved from this position, the piston valve *B* is forced back to its original place by the pressure of the air. This releases the exhaust and allows the plunger and gate to descend. The rapidity of this descent may be controlled by the valve *F* to any desired speed.

In the ordinary operation of hoisting, the contact between the cage and the end of the valve piston rod is only momentary while the cage is passing that point. Consequently, the amount of air admitted to the main cylinder is not enough to start the plunger from its initial position, and the gate therefore remains stationary.

This gate can be easily arranged so that temporary removal of one of the guides on the opposite side from the plunger will allow it to be swung open for the loading of long rails or other material upon the cage.

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## Prevention of Freezing in Air Drills

"Freezing" at the exhaust of rock drills, due to the sudden expansion of compressed air, and the consequent deposition of entrained moisture, is sometimes a cause of serious delay in winter drilling. Numerous expedients are available to overcome this difficulty. The most satisfactory, says *Mine and Quarry,* is to place a water trap near the drills at a low point in the air line, in which the water carried in the air may be condensed and the air thus dried. Reheating of the air is also valuable; and in addition, secures an increase in efficiency.

Another method is to provide the drills with valves having a larger clearance. Valves for use with steam are often furnished with air drills because they are ground with a smaller clearance in the valve chest than the regular air valve, and are, of course, more economical. When freezing is threatened, air valves, with a clearance three or four times greater, should always be substituted.

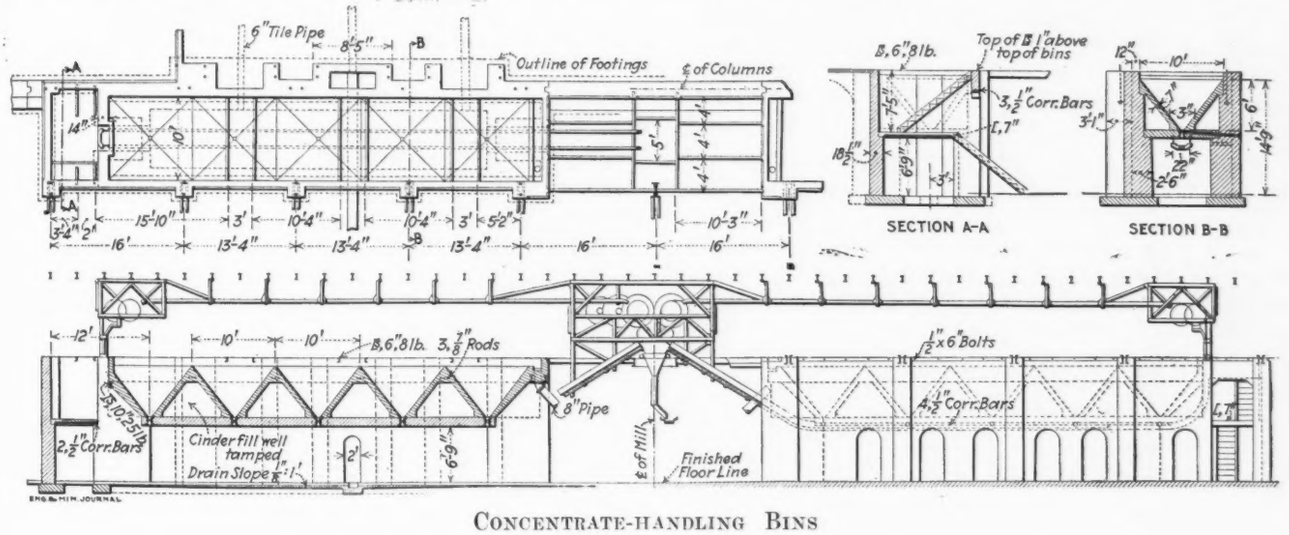
When reheaters and water traps cannot be used, cup grease has been found effective. The grease is fed into the machine about a cubic inch at a time through the throttle, and one application per shift is usually sufficient to prevent trouble from freezing. The grease should be about the thickness of heavy vaseline. Wood alcohol has also been tried but its effect is not so lasting as that of the grease.

New drills are more susceptible to freezing than those that have been in use a week or two and are well limbered up. Tappet- or rocker-valve drills are much less likely to freeze than those with differential, or spool-valves.

# DETAILS OF METALLURGICAL PRACTICE

## Doe Run System of Handling Concentrates

At the new mill of the Doe Run Lead Co. near Rivermine, Mo., the concentrates from the different parts of the mill come to a common bin where they are dewatered. The jig concentrates flow into the bin by gravity while some of the table concentrates are raised by a Frenier pump to the bin. This bin is made of concrete and has a series of pyramidal compartments in the bottom, provided with 4-in. diameter openings through which the concentrates fall into a bottom trough along which they are moved by a scraper conveyor, up an incline at one end to the lip over which they are discharged in a sufficiently dry condition so that they may be taken by a flat belt conveyor to the gondola cars into which they are loaded for shipment to the smeltery of the St. Joseph Lead Co. at Herculaneum, 37 miles away.




CONCENTRATE-HANDLING BINS

During the time that they are dragged up this incline at the end of the concentrates bin they are drained so that they do not contain more than 10% moisture upon dropping to the belt conveyor.

The bins are made of concrete which is laid in two layers with a coating of asphalt between, so as to make the concrete impervious to water. The bin is of a rectangular section throughout, with the pyramidal bottom laid on top of a well packed filling of cinders. These pyramidal walls are seven inches thick and are reinforced with No. 12 gage, 1½-in. mesh, expanded metal. The V-shaped mass of concrete between pyramids is reinforced by three ⅞-in. corrugated bars. Also in reinforcing the horizontal bottom from which the pyramids spring, ½-in. corrugated bars are used. These are put in at 4-in. centers and are strung through two 9-in., 13¼-lb. channels that form the sides of the trough in which the scraper conveyors work. Alternate bars are turned up to take the shearing stress.

In order to enable the contents of any pyramid to be retreated, if desired, 1½-in. pipes were buried in the concrete, but these have never been used. The outer wall that helps carry the tank is cut into a series of arches, reinforced by four ½-in. corrugated bars, so as to help take the tensional stress over the arches; I-beams are used to reinforce the end walls. A 1:2:4 concrete mixture was used, the rock in which had been broken to pass a 1½-in. ring. When the bin was finished trouble was experienced from leakage around the corrugated bar reinforcements that supported the trough. Some of the concrete had to be chipped out and a calking of lead wool put in around the bolts. This stopped the leaks and no further trouble was experienced. The troughs in which the scrapers travel are made by bolting a cast-iron bottom to the channels. In order to allow the bolt to be put in easily and the assembling of the trough to be accomplished without any difficulty, the bolts go through slots ¾ in. wide and 1½ in. long, in the cast-iron bottom. These holes are placed at 6-in. centers along the trough.

The track for the rollers of the scraper conveyors consists of 2x⅜-in. wrought-iron straps, carried by 3x4x⅜-in. angles riveted to the channels. Top guides were put in, so as to prevent the conveyor from lifting off the track at the turn. These are 2x½-in. wrought-iron bars carried by clip fastenings cut from 3x3-in. angles that are riveted about 24 in. apart to the channels forming the sides of the trough. In assembling the trough, rubber gaskets $\frac{1}{16}$ in. thick were put in at all joints to make them water-tight.

The conveyor wheels are three inches in diameter and are connected together by links that carry the scraper blades. These scraper blades are perforated so as to allow the concentrates to drain better. In order to prevent breakage resulting from the chain on one side being worn more than that on the other, the scraper blades

are carried from the chain links by swivel connections so that one chain can work ahead of the other without throwing any bending or shearing stress on the scraper carriers.

The chain returns on an overhead track after passing around the sprockets at the end. In order to catch the drip from the returning conveyor, catch pans are carried along under the return tracks. These run down at frequent intervals to the level of the concentrates tanks so as to return the dripping. Walks over the concentrate bins are carried across where the catch pans are high up, next the tracks. The conveyors are run at a speed of about 12 ft. per min. and it takes a total of 5 hp. to run them. As the pull on the conveyor is at times between 3000 and 4000 lb. a belt conveyor is out of the question for such service. The travel of the conveyor under water and in water laden with sulphides is hard on the bearings, while there is considerable wear on the scrapers. There are two of these conveyors, one for each section of the mill and each conveyor handles about 100 to 150 tons of concentrates per day. The strains at the sprockets also come on the rollers and this is the chief cause of wear. Other than occasional casual inspection these concentrates dewaterers and conveyors require no attention. The cost of operating them is 3c. per ton of concentrates delivered to the belt conveyor, 2c. of this cost being for repairs and maintenance.

The chief wear on this conveyor is caused by grit getting into the bearings from the rollers and the pressure and turning when on the sprockets. A conveyor lasts about 18 months. In operating the conveyor a close watch has to be kept for broken links and as soon as one is found, the feed is turned to the other concentrate bin while the injured conveyor is immediately repaired, for in case the chain should break in two, some of the bottom plates would have to be taken off to get the conveyor into the launder again. Taking everything into consideration this seems to be a good way to handle the concentrates at large mills; also it may be possible to work up a cheaper system in which the concentrates are removed from a settling tank by a shovel wheel, but even with this arrangement, settling tanks would have to be provided.

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## Large Jaw Crushers

It is interesting to note that since the installation of the 84x60-in. jaw crusher at the trap-rock plant of the Birdsboro Stone Co., at Birdsboro, Penn., the Power & Mining Machinery Co. has sold two more of these machines, which are the largest size of jaw crushers ever built. One of these has been contracted for by the S. B. Martin Trap Rock Co., Siborn, Mich. It will be used in connection with a No. 8 gyratory and four No. 6 gyratory crushers, for crushing trap rock. The crushers have a nominal capacity of 500 tons per hour to 10 in. At the Birdsboro plant the large jaw crusher is operated in connection with five McCully gyratory crushers, one a No. 10, two No. 7, and two No. 6 machines. The usual output per day is 3000 cu.yd., though one day's output has reached a maximum of 4000 yards.

The other crusher of this size was sent abroad recently to the Loussavaara-Kirunavaara Aktiebolag, a Norwegian iron company, operating within the Arctic Circle. On account of conditions of transportation on the narrow-gage railroad, the crusher had to be sectionalized to about 15 tons.

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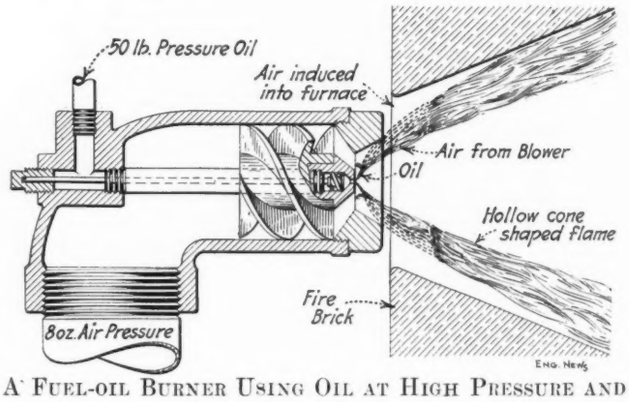
## The Stiltz Fuel Oil Burner

The common use of fuel oil under the boilers of mine plants makes the description of a new burner, as presented by *Engineering News,* of interest. The burner in question was designed in an attempt to increase the efficiency of oil combustion for boiler and metallurgical furnaces. A characteristic of many low-pressure oil burners has been their ineffective atomization of the oil and a consequent low combustion efficiency. Therefore recourse has usually been made to high-pressure air or steam for atomizing, but the general difficulty which seems to have been encountered here lies in the difficulty of thorough mixture of the oil particles with the proper amount of air on account of the high velocity of the former.

This design shown comprises an inner nozzle through which oil is forced at 50-lb. pressure. At the end of the passageway in this nozzle is a small orifice and within the passage is placed a spindle bearing a spiral fin, which




A Fuel-oil Burner Using Oil at High Pressure and Air at Low Pressure

is claimed to cause the oil on delivery to rotate and spread out in a cone-shaped film. Around the inner nozzle above mentioned is a casing through which air passes, and within this casing is a larger spindle also with a spiral fin, which it is claimed gives the air a whirling motion as it passes out. By the velocity of the air in a radial direction from the burner axis, a certain amount of suction seems to be produced which draws the oil particles into the current of air. This, it is claimed, results in the desired intimate mixture and atomization. The shape of the issuing flame is controlled by the shape of the bell mouth of the outer orifice.

It is reported that competitive tests, conducted in 1912, at the plant of the Link Belt, in Nicetown, Penn., showed that this type of burner required only about 31% of the amount of fuel of high-pressure burners in use. Sizes have been made to give a capacity range of from under one gallon of oil per hour to over 400. This design is the work of H. B. Stilz, 1938 N. Marvine St., Philadelphia, Penn., from whom this information was obtained. The device is patented.

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**The Rio Tinto Co.,** in Spain, recently contracted with the Power & Mining Machinery Co., for two more 12-ft. vertical converters of the Great Falls type, making six shells in all that were purchased during 1912 by this company.

# THE COST OF DOING THINGS

## Notes on Drifting, Sinking and Raising

The following notes were made up principally from data previously published in the "Cost of Doing Things." The table given herewith shows the cubic feet of ground removed per man-hour; further details of conditions may be obtained by referring to the separate articles as published. The costs for drifting, sinking and raising are seldom published in the reports of mining concerns, but the few that have been obtained are given.

At the Sons of Gwalia, Ltd., West Australia, the main shaft was sunk for 199 ft. during 1911, at a cost of $106 per ft.; 1309 ft. of winzes at $20.63 per ft.; 1086 ft. of raises, at $16.05 per ft.; 3759 ft. of drifts were run at an average cost of $18.09 per ft., and 1499 ft. of crosscuts at about $18.20 per ft. These charges are for underground expenses only.

The Wolverine Copper Co., Michigan, in its 1911 annual report reported 541 ft. of shaft sinking, at a cost of $15.34 per ft., which is evidently only the bare underground charges in the shaft; 4293 ft. of drifts were run for $6.12 per ft. The Mass Consolidated Copper Co., Michigan, sunk its "C" shaft 152 ft., at a cost of $222 per ft.; drove 6410 ft. of drifts for $5.75, and 466 ft. of crosscutting at $4.40 per ft. These figures are for underground charges only. The Elkton Consolidated, Cripple Creek, Colo., in 1911, reported 2684 ft. of drifts, at a cost of $4.02, made up of labor and powder, and 82 ft. of raises, at $4.62 for the same items.

In the ENGINEERING AND MINING JOURNAL of June 25, 1910, p. 1325, C. Everard Arnold gives the cost of raising 948 ft. of the Giroux Consolidated Mines Co.'s shaft, at Kimberly, Nev., at $71.21 per ft., made up as follows: Labor raising, $16.69; labor tramming, $5.09; labor timber framing, $1.76; blacksmithing, $1.19; machine shop, 11c.; teaming, 54c.; air compressor, $10; supplies, $17.24; hoisting, $15.15; and proportion of underground expenses, $3.44 per ft. raised. The raise was cut 18x21 ft., and was supported by square sets.

It is stated, in an article by R. S. Rainsford, p. 514, of the JOURNAL, Mar. 11, 1911, that 283 ft. of the Argonaut Mining Co.'s shaft, Jackson, Calif., was sunk at a cost of $43.11 per ft. for the following items: Drillers, $19.94; engineers, $5.54; timbermen, 78c.; powder, $3.74; fuse, 48c.; caps, 10c.; candles, 56c.; timber, $8.13; track, $1.07; power for hoist, $1.67; and power for drills, $1.10 per ft. The shaft, outside of timbers, was 16.4x9.1 ft. and was on an incline of 60°, all work was done on the bonus system and at the rate of about 50 to 60 ft. per month. At a Michigan iron mine the cost of sinking 184 ft. of shaft was $31.64 per ft. for the following: Labor, $23.60; supplies, $1.65; explosives, $3.32, and timber, $3.07 per foot.

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## Consolidated Gold Fields

For the year ended July 31, 1912, the Consolidated Gold Fields of South Africa group on the Witwatersrand produced 946,520 oz. of fine gold from 3,616,330 tons of ore crushed, giving an average yield of about 0.384 oz. per ton. The cost per ton for mining and treatment was 14s. 9.264d. ($3.59), exclusive of renewals and additions to plant. The treatment charges, including crushing and transport of ore, were 3s. 8.264d. ($0.89) per ton.

There were employed an average of about 20,700 men of all races, including those working for contractors; so that the yearly production per man was approximately 177 tons. Assuming 305 shifts work for the year, the daily production per man was 0.58 ton approximately.

The tons crushed per month per native on surface work was increased to 90.56 tons in July, 1912, an increase of 11.95% over the corresponding month for 1911. The tons mined per month per native underground, excluding those engaged on development, was 29.75 tons, an increase of 4.79%. The development footage per native engaged in development was 10.34 ft., an increase of 6.27%. This increase is largely the result of investigating and introducing labor-saving machinery.

DRIFTING, RAISING AND SINKING COSTS AT VARIOUS MINES

| Mine | State | Nature of Ground | Size of Working Feet | No. of Men | Length of Shift Hours | Drilling Time Hours | Cubic Feet Material per Man-hour |
|---|---|---|---|---|---|---|---|
| Drifting: | | | | | | | |
| Fittsburgh-Silver Peak | Nev. | Fairly hard | 5x6 | 2 (b) | 8 | 5.5 | 7.5 |
| Greene-Cananea | Mex. | Hard quartz | 4.5x6.5 | 2 (c) | 9 | 6 | 4.74 |
| Ohio Copper Co. | Utah | Medium hard quartz | 6x7.5 | 1 | 8 | 5 | 17.0 (d) |
| Mammoth Copper Co. | Calif. | Porphyry | 7x9 | 2 (c) | 8 | 6 | 9.7 |
| North Star | Calif. | Hard granite | 6x8 | 1 | 8 | | 21 (d) |
| Erie Consolidated | Calif. | Slate and quartz | 5x7 | 3 (a) | 8 | 5 | 5.84 |
| Raising: | | | | | | | |
| Pittsburgh-Silver Peak | Nev. | Fairly hard | 5x4.5 | 1 | 8 | 4 | 8.45 (e) |
| Green-Cananea | Mex. | Hard quartz | 6x11 | 2 | 9 | 6 | 11 |
| Ohio Copper Co. | Utah | Medium hard quartz | 4x5 | 1 | 8 | 5 | 12.5 |
| Mammoth Copper Co. | Calif. | Porphyry | 6x12 | 2.3 | 8 | 6 (f) | 7.46 |
| North Star | Calif. | Granite | 6x10 | 3 (g) | 8 | 7 | 5.66 |
| Erie Consolidated | Calif. | Slate and quartz | 5x7 | 1 | 8 | 5 | 26 |
| Sinking shaft: | | | | | | | |
| Goldfield-Merger | Nev. | Medium hard | 7x16 | 5 | 8 | 3 | 3.56 (h) |
| Goldfield-Merger | Nev. | Variable medium to soft | 7x16 | 6 | 8 | 2.33 | 3.27 (i) |
| Greene-Cananea | Mex. | Hard limestone | 7x15.5 | 6 | 8 & 9 | (j) | 1.4 |
| North Star | Calif. | Hard diabase | 9x18 (k) | 4 | 8 | 4 | 5.22 |

(a) One driller, one trammer and one shoveler. (b) One driller and one mucker. (c) Presumably one driller and one mucker. (d) Mucking and tramming are evidently not included in this figure. (e) One and one-half hours timbering included. (f) Two machine drills operated. (g) One driller and two shovelers. (h) This record was made sinking from about 470 to 700 ft. by churn drilling 60% of the holes and hand-hammer drilling the remaining 40%. Of the total time 37.4% was taken up by drilling and blasting, 40.4% mucking out, etc. and 22% timbering. (i) This record was made sinking from about 700 to 1200 ft. depth with four machine drills operating. About 29.2% of the time was taken up drilling and blasting, 15.6% mucking out, etc., and 8.7% timbering. (j) Drilled one 5-ft. round per day. (k) 45° incline shaft.

# Iron Ore Resources of Chile

*SYNOPSIS—A brief catalog of the iron-ore resources of Chile is given, together with a list of the ports through which they would be shipped. The most important known are the Tofo mines, recently acquired by Bethlehem Steel Co. interests.*

The iron deposits of Chile are distributed over almost the entire country, but occur principally in the center, forming an almost continuous line from north to south. Practically all iron minerals are found except siderite (carbonate of iron). Apparently all the carbonates have been decomposed into oxides through the high temperatures occasioned by the sudden upheaval of volcanic rock.

### Chilean Deposits Marked by High Iron Tenor

In most of the large deposits hitherto discovered the percentages of iron have been high, ranging from 55 to 70½%. The phosphorus varies from 0.09 to 0.3% in some of the deposits, and falls in others to as low as 0.02%, and even lower. The phosphorus usually is found as apatite, forming whitish veins visible to the naked eye and frequently capable of being removed by screening or by mechanical concentration, as is done in Sweden. The percentage of phosphorus tends to diminish with the depth and is highest in the upper portion of the ferruginous deposits. Sulphur is seldom met with and then cnly in small quantities.

The principal mines which have been worked in Chile for iron have been: The Tofo mines, hitherto belonging to the Société Francaise des Hauts-Fourneaux du Chili, but recently acquired by the Bethlehem Steel Co., Aguas Buenas, high up on the coast of Cardos (in the department of Ovalle), which have been worked on a small scale for some years, shipping ore to Antofagasta as fluxes for siliceous silver ores at the works of the Cie. de Huanchaca at Bella Vista; and a mine in the neighborhood of Taltal, the ores of which have been worked for other metals.

The most important deposits described by Mr. Vattier are enumerated below:

### Antofagasta Province

About 20 km. to the east from the port of Mejillones, the mining center of the Cerro Cordo, in the department of Antofagasta, there are thick veins and seams of iron oxide, which often appear mixed with copper and manganese ore. For about 50 years Cerro Cordo and other regions on the coast in the neighborhood of the port of Antofagasta have been worked for iron ores, used as a silver-ore flux. Toward the south, near the port of Taltal, are found the more important iron-ore deposits of the province of Antofagasta, including the Potrero mine.

To the north of Taltal there is a small place called Hueso Parado, overhung almost perpendicularly by the mountains containing the iron-ore deposits. It would be easy either by means of an inclined plane or by an aërial ropeway of about 500 m. in length, to lower the iron ores of one of the principal deposits directly to a loading stage in Hueso Parado Bay. The deposits found on this mountain occupy a surface of 100 hectares, the concession for which is held by the local residents. The ores are found in the form of veins 10 to 15 m. thick. At other points, seams which appear to be of equal thickness are traversed by sterile dikes, in which syenites and diorites predominate. Further north and at a still higher level in the direction of the concession known as Norte Magnetico the ores appear to be of great purity and abundance. Samples of these ores sent to Holland and excluding one of 51% iron content show a range of 62.84 to 64.35% Fe; 3.1 to 8.7% $SiO_2$; 0.03 to 0.054% P and traces of sulphur.

Seven kilometers to the east of Taltal and near the line of railway which connects it with Aguas Verdes, it is possible to follow outcrops of red hematite forming veins of varying thickness on the mountains which dominate the valley. This mountain region is known as Cachina. A little further south, in the Cifunchos region, outcrops of iron ores have been recorded, but most of the deposits are covered by alluvial matter. With regard to the iron ores of Cachina which show outcrops of 20 m. in thickness over a distance of 2000 m., the following analysis is given by a Chilean commission: Iron oxides from 78.67 to 83.73%; silica, 9.37 to 11.2%; lime, 0.2 to 0.6%; sulphur, 0.65 to 1.76%; phosphoric acid, 0.057 to 0.098%. From the investigations of the committee it appears that most of these deposits are of only scientific interest and lie outside the scope of a study relating to the workable deposits of iron ore. It would appear from examining the reports that the iron ores are often associated with copper and that abundant deposits of iron titanates and sulphides and sulphates of iron are to be found in these regions.

### Richest Ores in Atacama and Coquimbo

The provinces of Atacama and Coquimbo possess the most abundant and best known deposits of iron and contain the purest ores. About 30 km. from the port of Pan de Azucar, several deposits of iron oxides have been discovered containing, according to samples analyzed in Europe, from 44.97 to 49.89% of iron. In the department of Chañaral are found, in addition to deposits of cupriferous iron ore, important deposits of ore containing high percentages of iron oxides, but these would probably at greater depth become cupriferous. In the neighborhood of the ferruginous copper mines of Tres Gratias (65 km. from the harbor) and of Carmen, there are found numerous hummocks, the sides of which show pure oxides of iron stratified with zinc and pieces of iron ore, containing 65 to 68% of iron.

In the department of Copiapo, near Tierra Amarilla, about 115 km. from the coast, thick veins of iron oxides have been found, the outcrops of which are visible from the foot to the summit of a high mountain. These deposits could be advantageously worked and transported by the existing railway to the port of Caldera, a first-class harbor, one of the best on the Pacific, possessing a magnificent quay from which it will be possible to load the steamers direct. On the Chamonate estate, in the neighborhood of the town of Copiapo, important deposits of highly manganiferous iron ores are now being worked. A few kilometers from the railway line, near the Monte Amargo station, iron oxides are being worked and sent for use as fluxes at copper smelteries. These iron oxides contain for the most part copper varying from 1½ to 2½ per cent.

Note—Abstract of a paper presented by Charles Vattier before the Iron and Steel Institute, September, 1912.

In the Carrizal region, in which the rich manganese ore deposits of Coquimbana and Negra are being worked, and near Canto de Agna important deposits of iron ore exist which it would be easy to transport by rail from Canto de Agua to the coast, 28 km. In the department of Freirina several outcrops of manganiferous iron oxides have been met with. However, the most important iron-ore deposits in the province of Atacama are found in the department of Vallenar, a few kilometers from the town of Vallenar, while on the plateau above the town numerous outcrops of iron ore appear. These outcrops have been worked for use as fluxes at the blast furnaces of Antofagasta for smelting siliceous copper and silver ores. A few kilometers from Vallenar the immense iron-oxide deposits of Ojos de Agua are met with, forming the bulk of a huge mountain, the two black sides of which, composed of practically pure iron oxides, are visible at a great distance. This mountain mass displays iron oxides in the form of thick seams of enormous layers intersected by several sterile dikes, and in the lower portion by some cupriferous veins. Huge blocks of several hundred cubic meters in volume and large lumps and nodules of the ore are found on the slopes of the mountain and on the surrounding uplands. An analysis of samples of these minerals shows 63.3% iron; 0.137% phosphorus, and 0.069% sulphur.

About 14 km. to the southeast and near the Perdices and Rosario mountains and about 65 km. from the port of Huasco, the deposits of Algarrobo and Algarobillo are found. These deposits, like those of Ojos de Agua have been conceded for some years to a French syndicate, which has planned a line of railway about 55 km. long, to Huasco Viejo Bay, near the port of Huasco. Analyses made at the Creusot works in 1909 show from 68 to 69% iron; sulphur, from 0.015 to 0.042%, and phosphorus, from 0.010 to 0.048%. According to the owners of the Algarrobo mine, the superficial deposits of iron ore are superior to those of Kirunavaara, Sweden, 755 hectares of workable outcrops having been established, occupying a surface area of 1175 hectares.

Further south in the desert, near the boundaries between the province of Atacama and Coquimbo, numerous outcrops of iron ore are met with, as frequent boulders and lumps disseminated over the surface of the soil. These concessions belong to companies at Antofagasta, Serena and Santiago respectively, and are known as the Cristales, Ratones and Pleito. The ports of embarkation for these minerals would be Sarco, Apolillado or Los Chorros. According to an engineer on the committee investigating these deposits, the Cristales may contain 30,000,000 or more tons. In the same region, further east, about 60 to 70 km. from the coast, there are several large deposits of manganese ore.

### The Tofo Mines in Coquimbo Province

In the department of Serena lie the Tofo mines before spoken of. These deposits may be regarded, both as to quality and quantity, as the most important in Chile, and are situated in the province of Coquimbo in the department of Serena, about six kilometers west of the well known copper-mining district of Higuera, and 7½ km. to the east of Cruz Grande Bay. The area of the concession is 87 hectares. The Tofo deposits derive their name from their proximity to large deposits of white clay, and are but a small fraction of the great deposit which extends from north to south in Chile. They are stratified deposits of sedimentary origin. The strata revealed by an open crosscut made at a lower level at a spot called Placilla, rest on compact graphitic rock, often consisting of quartzite. These iron deposits have undergone upheaval and have been transformed into a perfect mountain, having the appearance of massive iron oxides traversed by a few sterile dikes containing quartzites, amphiboles, syenites and chlorites. A portion of these deposits has been shattered at a number of points by volcanic eruptions and numerous huge blocks, lumps and granules of pure iron ores are met with, filling the small valleys.

There are three dikes which traverse the main mass of iron oxides normally in the direction of the strata. The most southern is scarcely 1 m. in thickness. The central dike, which is associated with parting rock showing considerable decomposition, reaches 25 m. in thickness, while the most northerly, which is rather irregular and can be followed only for a short distance, appears to have an average thickness of 1½ m. The upper portion of the deposit forms two separate peaks separated by a ridge. The most northern peak is 80 m. higher than this ridge, and the southern peak is 25 m. higher. To the south the deposit may be followed to a level of 100 m. below the ridge referred to, being covered toward the north partly by the débris of the surrounding rocks and partly by an agglomerate containing a considerable admixture of iron ore. At one point the deposit of pure ore is visible for over 750 m. with an average thickness of 150 m. A conservative estimate of the engineers of the company lately owning this deposit is 69,000,000 tons of ore in sight, containing 68% iron and less than 0.025 per cent. of phosphorus, while Mr. Vattier estimates that at least 145,000,000 tons may be assumed there. The phosphorus is most abundant in the upper portion of the peak and in the outcrop.

### Method of Working

The methods of working are simple and can be initiated by quarrying, proceeding later as in Sweden and Norway, by terrace workings of 10 to 20 m. in height. The ores are transferred by an aërial ropeway over a distance of 7.2 km. from the mine to the bay of Cruz Grande. Each bucket holds on an average of 500 kg. of ore. The difference in the level of the mine and the bay is 700 m., which allows the buckets to descend by gravity and furnishes valuable surplus power.

Following the cart way from Higuera to Serena, Quebrada Honda is passed. Here have recently been laid bare deposits of excellent iron ore, the del Jardin concession, which continuing southward, forms the mining centers of Juan Soldado and Romeral. An engineer of the Chilean government reports that this whole region seems to be one vast iron deposit. The ore could be transported by a railway of about 10 km. in length as far as Punta Teatinos to an elevation overhanging the sea.

### District of Huachalalume

A few kilometers from the port of Coquimbo and near Pan de Azucar Mountain in the Santa Elena estate, there appear near the summits and western slopes of small mountains, situated near the buildings of this estate, important outcrops of iron ore. The ores could easily and cheaply be transported as far as the port of Coquimbo, either by narrow-gage railway of low gradient along the

plain as far as the port, or by a branch line from the Serena-to-Coquimbo railway.

### The Aguas Buenas Mine

On a line of the railway connecting Coquimbo with Ovalle, in a region formerly rich in copper mines and close to the station at Peñon, thick veins of cupriferous iron oxides appear, attaining over 10 m. in thickness. They are situated on the summit of the mountain and are worked as fluxes with the silver ores at Bella Vista and Antofagasta. They carry 57.46% Fe, 0.009% S, 0.002% phosphorus.

It is, however, on the side of Los Cardos, and before arriving at the station of Pejerreyes (68 km. from Coquimbo) that the iron mines proper are found, such as those of Agua Buenas, which have been worked for about 15 years in order to furnish fluxes for silver ores, and sent to Antofagasta for the Playa Blanca works of the Huanchaca company. The deposit is not at present being worked, but was worked by opencast methods, the blasting being carried on with the black powder of the district, and the ores were lowered by a double inclined plane at a distance of about three kilometers from the mine, to the railway. The ore carries from 55 to 63% Fe and is low in phosphorus and sulphur.

Several kilometers from the town of Ovalle and along the edge of the road leading from Ovalle to Punitaqui, nearly opposite the copper mines of Tamaya, appear numerous boulders and lumps of oligistic and magnetic-iron oxides derived from the erosion of numerous extensive deposits occurring in stockwork layers and overlying banks, outlined in and springing from numerous hills which may be followed for a distance of several kilometers, extending beyond Trapiche, the new terminus of the railway, which descends to the port of Tongoy. It is claimed that by simply loading up the débris strewn over the surface and working by opencast methods and at little depth, a large tonnage of high-class ore could be obtained, while good ore has been shown in depth by a gallery driven in the lower portion of these deposits in the attempt to discover copper ore.

Transportation would be either to the port of Tongoy or to Coquimbo itself. At five kilometers to the south of Illapel, on the carriage road from Illapel to Combarbala, hematites of great purity have been worked for use as fluxes in the blast furnaces installed at Illapel, which at present are idle. The outlet for these ores would be the harbor of Los Vilos, connected with Illapel by a railway 68 km. long.

### Provinces of Aconcagua and Valparaiso

It is chiefly in the department of Petorca, in the province of Aconcagua, that extensive deposits of iron ore have been found; for instance, those of Iman near Tilama. The deposits are magnetic iron oxides traversed by sterile dikes, and the outcrops appear over a considerable extent of territory. These and other deposits of iron distributed on the sides of the hills at Langotoma could be worked easily and cheaply, their outlet being through Pichidangui Bay. Near Calera, in the same district, ores high in iron, of exceptional purity, have been worked for the last 20 years as silver-ore flux.

While a large number of iron-ore deposits are known in the province of Santiago, the difficulties of working and the cost of transportation have rendered exploitation of these deposits impracticable for the time being. For over 20 years iron ore has been extracted at Pelvin, in the department of Victoria, as copper-ore flux for the Maitanes smeltery, though the work is now at a standstill.

Near the station of Parral, at San Manuel, on the summit of a mountain 840 m. above sea level, is a large outcrop of magnetic iron ore. In this district is ample vegetable fuel and hydraulic power. A small cupola at Membrillos has made a good white pig iron using these ores and charcoal. Outcrops have also been described at Coronel and Araucania, much further south, but no serious prospecting has been carried on, and the deposits are at a considerable distance from the coast and the railway. Near Union, 75 km. to the southeast of Valdivia, are numerous limonite deposits carrying 35 to 39% of iron and finally, near Punta Arenas, the Chilean harbor on the Strait of Magellan, it appears that outcrops of iron had been met recently, though the samples were high in phosphorus. From the description of the deposits as given, it can be seen that in estimates of the iron-ore resources of the world, those of Chile deserve serious consideration.

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## Amargosa Valley Nitrate Prospects

According to Circular No. 73, of the Bureau of Soils, U. S. Department of Agriculture, nitrate indications have been discovered in Amargosa Valley, along the line of the Tonopah & Tidewater Ry., near the stations of Morrison's Siding and Sperry, Calif. Tecopa, Nev., is the nearest supply point.

The basement of this region is a series of limestones, schists and quartzites, probably Cambrian, on which are gravels, sands and clays of variable character, supposed to be Tertiary. Some of the gravels are cemented by calcium carbonate into a sort of conglomerate resembling some of the Arizona and Texas *caliches*. Not infrequently the clays are saline, and thin intercalated layers of gypsum are frequent.

The indications of nitrate are found in low rounded hills of the clay strata of the Tertiary strata mentioned. These hills have been greatly eroded, and their surface is a loose, structureless clay formed by weathering of the original stratified clays. This coating of loose material is from 10 to 30 in. deep, and below it lie tilted stratified clays, sometimes exposed by recent erosion. The loose surface clay is rarely saline, but occasional salt efflorescences are visile where shallow holes cause a concentration of rain water.

Samples were taken showing from 0.19% $NaNO_3$ in the loose surface materials at Morrison's Siding to an underlying clay showing 12.28% $NaNO_3$. The efflorescences were more chloride and sulphate than nitrate of soda, containing as low as 0.02% $NaNO_3$ in certain cases. The value of the beds is problematic. The only hope is in finding a large underlying bed of tenor similar to the clay showing 12.28% $NaNO_3$, quoted above. No such bed has yet been found.

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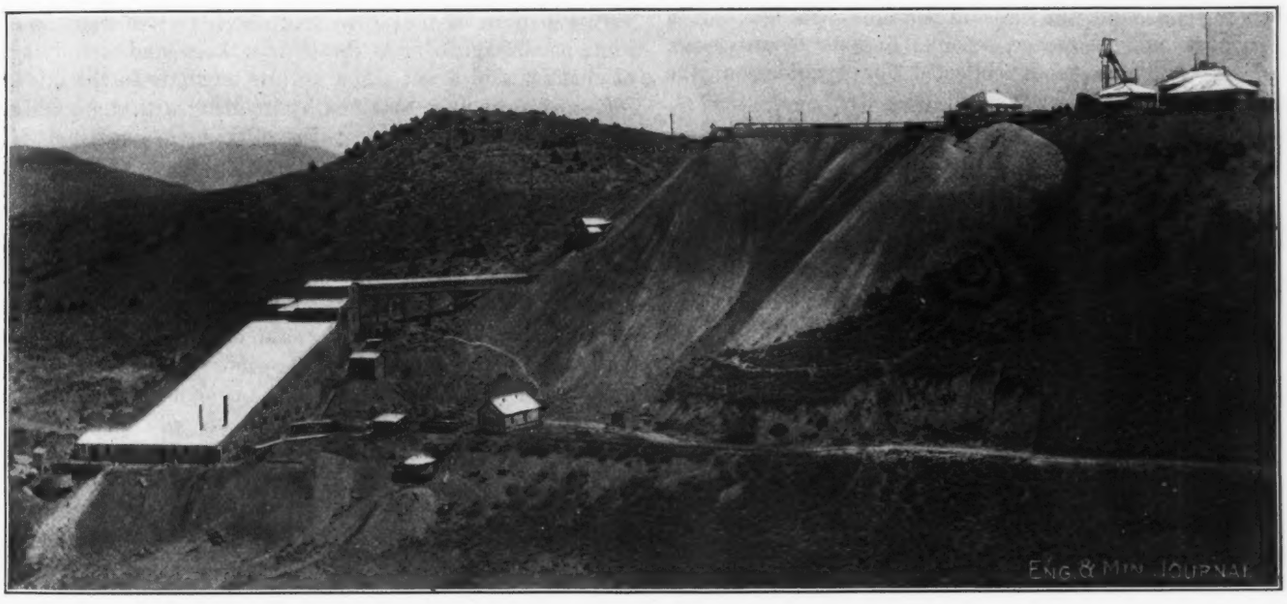
**Sand Cement** is specified for all major concrete work in the new Arrowrock and Elephant Butte dams of the U. S. Reclamation Service. This, according to specifications quoted in "Engineering News," is cement reground with an equal portion of granite, sandstone or other suitable material and is used in the same manner and in approximately the same ratio as portland cement.

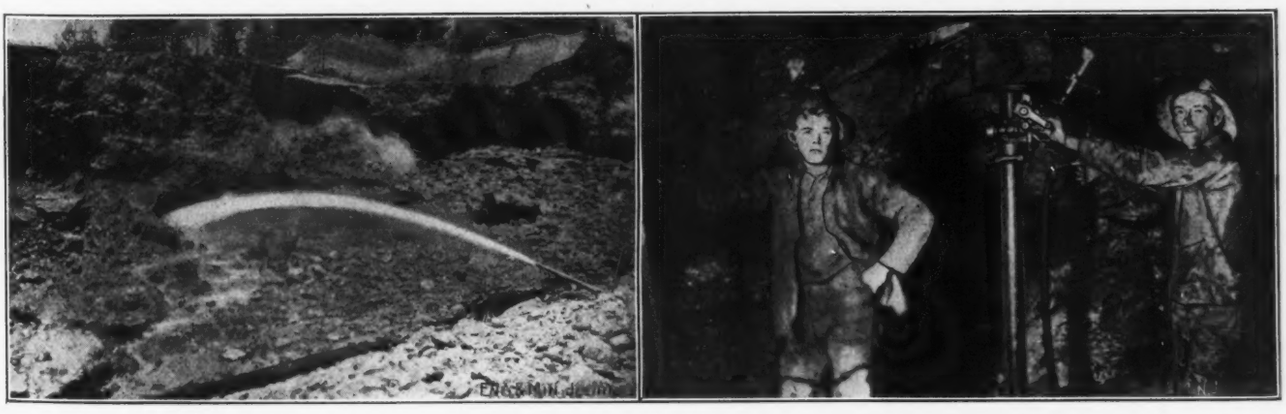
# PHOTOGRAPHS FROM THE FIELD

RESULTS OF SCIENTIFIC METHODS OF RAILROAD DESTRUCTION APPLIED BY PASCUAL OROZCO

(With the aid of a wrecking derrick 200 miles of track between Chihuahua and El Paso were pulled up by Orozco's followers. A locomotive was used to pull down telegraph wires. Ties, telegraph poles and bridges were burned)




MEXICAN MILL AND UNION SHAFT ON THE COMSTOCK LODE, VIRGINIA CITY, NEVADA



HYDRAULIC AND DRIFT MINING AT THE GOLD RUN MINE, PLACER COUNTY, CALIF.

# Electrolysis of Low Grade Gold Bullion

By Theodore W. Bouchelle *

*SYNOPSIS—Experiments in the chemical and electrolytic refining of a low-grade gold bullion, upon which a prohibitive export tax had been levied. Copper and silver are dissolved and a gold mud, over 920 fine, remains behind.*

During the latter part of 1905, at which time I was metallurgist for the Lone Star mine, in the Pis Pis district of Nicaragua, it became necessary to draw on the ores of the transition zone to supply the mill. Prior to this time the mill had been running principally on ore from the oxidized zone, which was from 50 to 100 ft. in depth, following more or less the contour of the outcrop of the vein, from which practically all sulphides have been leached by the copious infiltration of surface waters. The removal of all the heavy sulphides not only left the gold in good shape for amalgamation, but decreased the specific gravity of the ore with consequent increase and concentration in the value. Mining operations having started in the oxidized zone, the ore was sent to a stamp mill, crushed and amalgamated over copper plates and the tails at first disregarded; for a short time only, however, when a number of vats were installed and the sands collected for cyanidation, the slimes being thrown away.

### High Copper Bullion From Copper Carbonate Ores

As long as operations were confined to the leached zone the results in the cyanide plant were fairly satisfactory, although the bullion at all times showed a copper content; but when ore was mined from the transition zone and copper carbonates were encountered, the copper content of the zinc-box sludge often raised to as high as 92% copper. However, but little extra trouble was experienced in handling this low-grade bullion and bars assaying as low as 6.7% gold were exported to the United States Mint in New Orleans. Subsequent development of the orebodies showed copper in the unaltered or "sulphide" zone, principally in the form of chalcopyrite, and the presence of the carbonates in the transition zone above was no doubt due to the leaching and decomposition of these sulphides and secondary deposition as carbonates.

The first and most serious blow to the mine was the placing of an export tax on gold bullion by the Nicaraguan government. The law reads in effect that a duty of 56c. per oz. troy shall be imposed on all gold exported, but the grafting officials interpreted this to mean bullion, hence a 1000-oz. bar of bullion, containing perhaps no more than 100 oz. of gold, has to pay $560 export tax, which in this case amounted to 25 to 30% of the gross output of the cyanide plant and was entirely prohibitive. It is understood, of course, that this applies only to the low-grade product of the cyanide plant, as the gold recovered from the mill plates usually ran about 600 to 750 fine. I made numerous attempts to refine this low-grade bullion economically and though without success at first, the experiments were interesting.

Note—Edited by Henry B. Kaeding, mining engineer, care A. I. M. E., New York, N. Y.

*Metallugical engineer, Bluefields, Nicaragua, C. A.

### Refining Copper Bullion By Chemical Processes

The first method tried was that of matting, which was quickly found to be unsuitable due to: (1) Large gold loss; (2) having no means of reducing the matte on the ground; (3) prohibitive freight rates to the smelteries of the United States. It should be mentioned in this connection that fuel is extremely costly at this mine, our fuel oil for assaying and smelting purposes costing us 50c. per gallon.

The second method tried was that of treating the precipitates to a bath of hot sulphuric acid in the usual way to remove short zinc, etc., and then to a bath of nitric acid. The results were but fair as to efficiency and the method was prohibitory in its cost of acids consumed. Cupellation was not a success on the product and again the high price of fuel entered into the calculation.

Smelting with potassium bisulphate and leaching out the base metals and their salts with hot water offered considerable encouragment, but I was again confronted with the high cost of chemicals, high freight rates and high percentage of loss due to breakage and dissolving of chemicals in a wet climate while en route to the mine.

Good results were obtained by smelting with manganese dioxide in clay crucibles; the flux used consisted of borax, 40 lb.; bicarbonate soda, 10 lb.; fluor spar, 5 lb.; manganese dioxide, 15 lb.; silica sand, 2 lb.; to every 100 lb. of dried and calcined precipitate.

The precipitate assayed 92% copper and the resultant bullion assayed 80.8% gold, but the method was abandoned in the laboratory partly on account of the cost of chemicals but principally because of the high value of the slag, which contained all the silver as well as a high gold value. Finally, coming to the conclusion that about the only elements at my command on which there was not a heavy freight or duty levied were air, water, and, having plenty of the latter, electricity, I decided upon electrolysis as the final solution. While my idea was to attempt the recovery of the gold, silver and copper in marketable form, no attempt was made to recover the copper in coherent form, it being sufficient to obtain the gold in the form of anode slime and the silver and copper together, as there is no export duty on either of these two metals; and the main object in view was to obtain this result in one operation.

### Electrolytic Equipment

After laboratory experiments conducted systematically over a period of several months, the following equipment was installed: One Type D.E.G. direct-current generator, form A1, three kilowatts, capable of delivering 500 amp. at a pressure of from two to six volts at a speed of 1800 r.p.m. This machine was belted to a line shaft which derived its power from a Pelton water wheel. The switchboard was made of piece of well seasoned native hard wood and carried a field rheostat, ammeter of 800 amp., one 800-amp. line switch and a smaller switch between the fields and the ammeter. The entire electrical equipment was furnished by the General Elec-

tric Co. and no trouble has ever been occasioned by the machine heating either through overload or momentary short circuiting although it has been frequently entrusted to the care of native workmen for hours at a time.

The cell for the electrolyte was constructed of well seasoned 2-in. plank, and was 36x24x15 in. in size, tightly caulked and well painted with P. & B. paint. This cell was supported on six legs that were tipped with glass insulators of the ordinary telegraph-line pattern.

Attached to the cell was a small air lift for the purpose of circulating the electrolyte; this consisted of a lead pipe with a glass tube for the air connection and was so installed that it drew the electrolyte from a point near the bottom of the cell and discharged it into a distributing launder placed over the top of the cell. This distributing launder was perforated with holes, each hole being directly over one of the cathodes, thus providing a steady stream of electrolyte pouring over each cathode. The air pressure required was 5 lb., which gave a flow of about 15 gal. of electrolyte per minute.

The anodes consisted of the bullion to be refined, which was of approximately the following composition: Gold, 14.6%; silver, 10.0; zinc, 2.0; copper, 73.4.

The bullion was melted and cast into rectangular slabs 20x12x¾ in. and each slab was drilled close to its upper edge to receive the hangers by which it was suspended from the busbar. The drillings were utilized as samples for assay.

Each slab or anode plate was then slipped into a snug fitting canvas sack and suspended in the cell from the busbar. It was found essential that the canvas sack be snug fitting as it then held the anode slime in place and prevented it from slipping or sloughing off and collecting in the bottom of the sack around the lower end of the anode. This condition having occurred previously was found to enfeeble the action of the electrolyte at that point and caused the lower edge of the anode to become detached before refining was complete.

### Sheet Lead Cathodes Used

The cathodes were made of sheet lead of the same area as the anodes; unfortunately the only material at hand was a thin sheet lead $\frac{1}{32}$ in. thick and trouble was caused by this becoming brittle under the prolonged action of the current and heat and breaking off, causing several temporary short-circuits; sheet lead $\frac{1}{16}$ in. thick would have been preferable.

The electrolyte was composed of: $Cu\ SO_4 . 5H_2O$ 17.6%; $H_2SO_4$, 5%; in aqueous solution.

It is important that the electrolyte be kept at the above proportionate strength and it should be tested twice a day for copper sulphate and free sulphuric acid and any deficiency made up. My experiments showed that an electrolyte containing less than 10% copper sulphate failed to dissolve all the silver from the anode while one containing little or no copper sulphate had practically no solvent action on the silver. As a hot acid solution of copper sulphate is an active solvent of iron and other metals, all nails or screws entering into the construction of the cell should be of copper. Better yet, the cell could be designed so that it could be assembled and clamped with keys or wedges instead of screws. The anodes and cathodes were arranged in multiple much the same as in copper refining, and were spaced with 6-in. centers. The anodes were suspended from the busbars by copper hangers or clips, each anode plate in its close-fitting canvas sack. The cathodes were suspended from the busbars by simply folding the lead sheet over the bars and securing with clamps to insure perfect electrical contact.

The cell was then filled to within about one inch of the top of the anodes and the circulation of the electrolyte started, after which a current of 50 amp. under two volts tension was used.

The temperature of the electrolyte during the process is an essential point and should be kept at 150° F. This can be accomplished by using metals of unequal resistance in the cathodes. Once each 24 hr. the anodes were removed from the cell and the anode slime removed with a stiff brush. This anode slime was of a deep lustrous black with a tendency to agglomerate or remain massive, much as the gold residue after a gold-silver assay cornet has been parted in nitric acid.

This anode slime was screened, washed and dried by usual methods and was found to assay from 920 to 970 fine in gold and I believe that further experimenting with the electrolyte will render possible better results. Success depends on keeping the temperature and strength of the electrolyte at the points indicated. By fusing the anode slime in sand or clay crucibles using manganese dioxide in the flux I obtained bars that assayed for shipment 970 fine in gold.

The copper formed on the cathodes in wart-like excrescences and was easily stripped from the lead sheet once each 24 hr. to prevent its building across to the anodes. This copper carries nearly all of the silver and assays but 0.03 oz. per ton in gold.

The ultimate disposal of this copper would depend upon locality; it could be sold to copper smelters or refiners, if such were within reachable distance, or if power were free as at the Lone Star, could be electrolytically refined at the mine with a lower current density, in which case the silver would remain as the anode slime. A small percentage of the silver would find its way into the electrolyte from which it could be precipitated as a chloride by sodium chloride. In experimenting along these lines an attempt was made to precipitate the silver as formed, but it proved unsuccessful owing to deficiency in my filtering apparatus, which permitted the precipitated silver chloride to become mechanically caught by the copper.

In using a high current density the dissolution of the anode proceeds with great regularity and the amount of untreated scrap was confined to the upper edges of the plates which protruded from the electrolyte. These pieces, constituting about 8% of the original weight of the anodes, were recast with the next lot of bullion.

### Costs

The cost of this method of refining to the Lone Star mine was so little in comparison to the amount of export duty and freight saved as to be almost negligible. Without including the interest and depreciation on the plant, which varies for each locality, and excluding the cost of power which in this case is free water power, the cost was found to be 37c. per 1000 oz. troy of bullion refined. As about 50 lb. of copper was recovered for each 1000 oz. of bullion refined, it may be readily seen that

the value of the copper, otherwise lost, more than pays for the entire cost of refining.

My thanks are due to Henry B. Kaeding, while manager of the Siempre Viva Mine, and to Mr. Torrens, electrician in charge of the power plants of the Mars and the Bonanza mines, for their co-operation in experiments, and encouragement and assistance in overcoming obstacles.

## George A. Koenig

Prof. George A. Koenig, an eminent scholar and scientist, died Jan. 14, in Philadelphia, where he had been called by the death of a daughter, at the home of his son, Dr. Augustus Koenig. Professor Koenig was the oldest member of the faculty of the Michigan College of Mines, with which he had been connected as professor of chemistry since 1892. Doctor Koenig is survived by his widow and two children, a physician and metallurgist, and Mrs. George E. Nitzsche, an artist and portrait painter.

Doctor Koenig was assistant professor of chemistry and mineralogy at the University of Pennsylvania from 1872 to 1879; professor of mineralogy and geology from 1879 to 1892, and professor of chemistry at the Michigan College of Mines since 1892.

In 1897 he invented a new method of assaying without muffle, and later took out a patent on an assay furnace to carry out these methods. In 1881 he patented a method for chlorination of low-grade silver and gold ores, and in 1911 a method of extracting vanadium from ores. In 1885 he published his "Chromometric Methods," a development of blow-pipe analysis, and in 1905 an elementary book on chemistry.

Doctor Koenig had a large and valuable collection of minerals, which he presented to the Michigan College of Mines. Among the new minerals discovered and named by him are: Hydrotitanite, randite, leydyite, alaskaite, beegerite, rementite, footeite, paramelaconite, mezapilite, mohawkite, keeweenawite, stibiodomykite, melanochalcite. He also reëxamined many other minerals and discovered diamond in meteoric iron.

He was a frequent contributor to leading foreign journals, was a member of the American Philosophical Society, the Academy of Natural Sciences, Franklin Institute, American Institute of Mining Engineers, Lake Superior Mining Institute, and other scientific bodies, and a member of the University of Pennsylvania Chapter of the Phi Kappa Psi.

Professor Koenig was born at Willstatt, Germany, May 12, 1844. He was educated at the progymnasium, at Kork, the School of Moravian Brothers, Lausanne, Switzerland, and at the Polytechnic School, Karlsruhe, Germany, where he received his degree of Mechanical Engineer. From 1863 to 1865 he was a student at Heidelberg, and from 1865 to 1867, at the University of Berlin, where he received his degree of Master of Arts and Doctor of Philosophy. Subsequently he attended the Mining Academy, at Freiburg, Saxony, for a year. He came to the United States in October, 1868, and manufactured sodium stannate from tin scraps in Philadelphia. He subsequently became the chief chemist of the Tacony Chemical Works, of Philadelphia, and during the winter of 1870, he examined for the Lennig Co. several old silver mines in Mexico, traveling much of the distance by stage coach, enduring many hardships, and having several exciting encounters with the Apache Indians.

While at the University, Doctor Koenig served on a number of important committees. He also served on the committee which investigated the Keeley motor. Doctor Koenig was held in high esteem, not only for his brilliant scholarship, but for his character and personal worth. He had those genial and magnetic qualities which won for him life-long friendships, not only among thousands of students who came under his charge during the 40 years of his career as a professor, but also with his associates and co-workers in scientific fields. He was noted for his fairness and impartiality.

## Experimental Treatment Plant at Colorado School of Mines

The Colorado School of Mines experimental plant is intended not only to furnish practical experience to the students of the School of Mines, but also to offer means for research work and provide facilities for testing ores on a commercial scale.

Preliminary tests are conducted with miniature apparatus, consisting of a 24-in. Wilfley table, a 4x6-in., two-compartment jig, a set of hydraulic classifiers, an automatic feeder, a 6x48-in. amalgamating plate and a set of cyanide agitators. For these tests a charge of $25 is made and a quantity between 10 and 75 lb. is requested. For intermediate-sized lots of from 100 to 1000 lb., a charge of $75 is made. Such lots are treated on small jigs and quarter-sized Wilfley and Card tables. Cyanide tests are made on 25-lb. lots and are charged for at the rate of $30. In the case of the tests noted, the necessary fire assays and wet analyses are included. The engineer in charge of the plant conducts the tests and furnishes a detailed statement of results, but neither he nor the School of Mines will supply advice on equipment for treating the ores tested.

If tests on carload lots are desired, the owners of the ore must supply an engineer to take charge of the work. Such parts of the full-sized equipment as may be necessary will be turned over to him and the charges, graduated accordingly, will be made by the day. This full-sized equipment consists of crushers, rolls, screens, jigs, regrinders, classifiers, tables and vanners.

For preparation and sampling, a daily charge of $50 is made; for concentration, $50; for amalgamation, $40; for cyanidation, $40; for magnetic separation, $10; for magnetic roasting, $10; for the electrostatic plant, $10; and for the use of the entire plant, $100; a deposit being required to cover all charges.

## U. S. Steel Plant in Canada

The Steel Corporation late in 1912 announced its intention of building a large iron and steel manufacturing plant in Canada, the location of which will be not far from Detroit and at a point where it will be able to receive raw materials and ship finished products by water as well as by rail. No details have yet been published with regard to this plant, but it is reported that work will be begun early in 1913. The land on which it is to be located has already been bought.

# CORRESPONDENCE AND DISCUSSION

## The Price of Copper

With the present satisfactory price of copper being maintained in the absence of hardly any buying orders, we are all entitled to our own guess as to the direction of the next fluctuation.

There is only one condition under which the price of any commodity may be maintained at a fixed point, and that condition is realized when consumption and production are in a unit ratio.

With copper at 17¾c. per lb. there is a sufficient margin of profit in all of the old districts to make the business attractive. The established mines are stimulated to increase their output—cash is available for addition to plant and equipment—reserves are liquidated as quickly as possible, and new exploration is undertaken. The main drawback to a rapid increase in production is the scarcity of labor. This is gradually overcome by the increased wages attracting recruits from less flourishing occupations. The final result has always been that production overtakes and passes consumption—there is a rapid drop in the price of the metal, exploration is discontinued, production is gradually decreased, and then the process is reversed.

Of the two methods possible for stabilizing this condition, namely, the curtailing of production or the increase of consumption, it seems strange that producers have confined their efforts to the former. This not only is illegal, but is unsatisfactory inasmuch as a few large producers soon find themselves "holding the umbrella" for all of the others.

The only real solution of a higher average price for copper is to increase the *per capita* consumption and this can only be accomplished by educating the consumer to new uses of the metal. Within the last year in New York we have seen a large percentage of the new office buildings, stores, etc., finish the first story with a facing of ornamental copper. There is one block of stores on Broadway where each is uniform in this respect. Had this comparatively new demand for the metal been created four years ago, we might have had a decidedly different average price for copper over this period. There are possibilities for new uses in building construction.

I would suggest that the Copper Producers Association assess their members in the ratio of their respective production for the previous year. The total of such assessments, which should be in the neighborhood of $500,000, to be expended on a campaign of general publicity, which would include nearly all of the general magazines, architects' and contractors' papers and possibly the newspapers. Part of the sum mentioned could be used for maintaining a research department to devise new uses for the metal.

The amount named would be sufficient to cover the field thoroughly and would constitute a tax of less than $\frac{1}{10}$c. per lb. on the present production. In other words, if the advertising succeeded in raising the average price ¼c. per lb., it would be paying 150% on the investment. The holders of copper stocks would be the eventual payers of the assessment which I estimate roughly, would be equivalent to about 3c. per share per year on the average dividend-paying stock.

An association of cypress-land owners has advertised consistently for the last few years with noteworthy success until the "wood eternal" is in general use. The local advertising of the Consolidated Gas Co. in New York has succeeded in largely increasing the *per capita* consumption even in the face of the increased use of electricity for heating and lighting.

WILLIAM BLAIR BAGGALEY.

New York, Jan. 6, 1913.

## The Situation in Mexico

Albert E. Blair's letter on p. 1017 of the Nov. 30 issue of the JOURNAL, has called forth much protest in certain camps. Mr. Godfrey's letter and the JOURNAL'S previous editorials certainly were true and correct.

Now, as to conditions down here. It is true it is peaceful in the Coahuila coal fields and on the railroads from Monterey to Mexico City. It is probably safe to go to Oaxaca, the big camps of Pachuca, and El Oro; Angangueo, Guanajuato and Teziutlan are also safe. These camps turn out the most metals.

The states of Morelos, Michoacan, Guerrero and parts of the states of Mexico and Oaxaca are dangerous in the extreme.

The National Railways will not guarantee you a safe trip from Mexico City to Torreon. At this very minute of writing (Dec. 15), Campos has been driven from Chalchuites, Zacatecas, which he sacked and has gone East and may cut the railroad at any time near Zacatecas.

Just two weeks ago, rebels burned a train of coal between Torreon and Velardeña, cut the railroad and fired on a passenger train.

I was in Durango, yesterday. The town was crowded with people from the ranches. I saw herds of cattle and loads of grain being driven into town to save them from the rebels who are looting and burning ranches. I met a mining man from Chalchuites. He reported that seven days ago they looted his town, burned all the stores, robbed him of his money and clothes and threatened to shoot him. He intends to try it again as now is the time to get bargains in mining property. All trains between Torreon and Durango are heavily guarded with soldiers. The line is safe for the time being, as long as the soldiers remain.

The line from Torreon to Chihuahua is safe today, but we look for it to be cut again at any moment. A passenger train was burned a few miles north of Chihuahua less than three weeks ago.

The line from Chihuahua to El Paso is exceedingly dangerous. The plain truth of the matter is that conditions are far worse and more dangerous than at any time in the last three years, during which time I have

been traveling in Mexico. They are getting worse every day. A man who has been in Mexico since 1879 said he never saw them so bad or dreamed the Mexicans capable of such actions. An old man, in Durango since 1860, said that the old Revolution of the '60s never produced such dangerous times as this. Both of them said no Mexican could ever settle affairs without outside help.

R. B.

Torreon, Durango, Mex., Dec. 15, 1912.

## Review of Butte Geological Report

In my letter in the JOURNAL of Jan. 18, 1913, I alluded to an illustrated lecture upon the microscopic study of opaque ores given by Prof. L. C. Graton and Joseph Murdoch before the New York Section of the American Institute of Mining Engineers, and erroneously referred to Dr. William Campbell, professor of metallurgy at Columbia University, as associate author.

In the discussion which followed the lecture, Doctor Campbell exhibited by micro-projection, a large number of ores and gave an interesting exposition of the results of his studies. In recalling the revelations concerning ore genesis and transformation given during that evening, I naturally associated Doctor Campbell with Professor Graton.

It seems fitting to use this opportunity to acknowledge the indebtedness which all students of processes of ore deposition and alteration owe to Professor Campbell for his happy conception of the use of the metallographic microscope to the study of opaque ores. His own work on ores, and that of Professor Graton and Mr. Murdoch have disclosed positive evidence concerning ore genesis previously unknown. The method is as great an advance in the study of opaque ores as petrography has been in the study of rocks.

WALTER HARVEY WEED.

New York, Jan. 20, 1913.

## Prospecting on Forest Reserves

Noting Messrs. Cutler's and Sheldon's letters (ENG. AND MIN. JOURN., Nov. 23, Dec. 21, 1912), on the lack of interest in mining, I can agree with both gentlemen on some points. The forest reserves are not a hindrance to the prospector. I am at present holding mining property in a forest reserve, and my experience for the last seven years, in and out of the reserve, inclines me to favor the reserve as the prospector's only friend in this age. We enjoy all our rights, with a few exceptions of minor importance. These are in relation to the cutting of timber, yet I have failed to see in this reserve anything but justice dealt out to the prospector; he gets his claim and the timber he asks for. Of course, this asking hurts the old prospector's pride and seems an inconvenience. Any claim that shows mineral has recognition by forestry, but forestry is opposed to locating claims with nothing upon them; in other words, worthless ground.

Outside of the reserves in this country, prospectors have had their troubles. Timber locators have entered lands where valid locations had been made, and work showing mineral had been done, and they have won from the prospector. This, it will be said by many, cannot be done, but I know of several cases where it has been. When a timber location can take claims that have been held and worked upon for six or seven years, I think it may be assumed that, had there been no forest service, this country from here to the coast would have been taken for timber, and it is the greatest undeveloped country left in the United States for the prospectors, as it is all a mineral country embracing 150 miles east and west, and over 200 north and south.

We cannot blame forestry, as it has at least protected this country from the timber grabber, "the miner's worst enemy." Forestry is his best friend at present and can be made a working friend.

Regarding the question of "Why Mining is Languishing?" I think we should remember that we are supposed to be based upon a metal money, but the national banks are now issuing currency on bonds and other securities not gold, nor do they have to have it. Consequently, if money can be made from bonds and other securities, of what use is it to mine, prospect, develop or cause or even encourage gold mining?

C. J. FRY.

Hutton, Calif., Dec. 20, 1912.

## Mechanical Efficiency in Crushing

R. S. Leach in the JOURNAL of Dec. 21, 1912, has made the point that in my original article, while promising to show the derivation of the formula $N = -10 \log S$, I did not do so. Here it is, to the best of my knowledge, without going into too many details.

(1) Let $P$ be the number of pieces into which a rock is crushed. (2) Let $N$ be a grade number which represents the number of times the number of pieces has been doubled by crushing.

When

$N = 1$, $P = 2$,
$N = 2$, $P = 2^2$,
$N = 3$, $P = 2^3$

or generally $P = 2^N$

This is the starting of the equation

$$P = 2^N$$

Then

$$Log\ P = N\ log\ 2, \text{ or } N = \frac{log\ P}{log\ 2}$$

(3) Let $S$ be the sides of cube or mesh aperture, then

$$P = \frac{1}{S^3}$$

Now if in the equation

$$N = \frac{log\ P}{log\ 2}$$

we substitute the value of $P$ in terms of $S$ we get

$$N = \frac{log\ \frac{1}{S^3}}{log\ 2}$$

then

$$N = \frac{-log\ S^3}{log\ 2} = \frac{-3\ log\ S}{log\ 2}$$

Now log. $2 = 0.301$, or for our purpose 0.3, therefore

$$N = \frac{-3\ log\ S}{0.3}$$

which is the same as $N = -10 \log S$.

ALGERNON DEL MAR.

Los Angeles, Jan. 8, 1913.

# EDITORIALS

## The California State Mining Bureau

It is a pity that state geological surveys and mining bureaus have to be the subjects of petty political squabbles. Only a few years ago the Missouri survey was thus being bothered. Now it is again the California State Mining Bureau, this organization having had previous experiences of the same kind. When Mr. Storms was appointed state mineralogist, not long ago, a good man was secured, one who holds professional respect, and under him there was a good chance that the State Mining Bureau might regain the prestige and usefulness that once it had. But, alas! politics have interfered.

Mr. Storms' requests for necessary appropriations have lately been rejected, apparently for political reasons, and last of all, to cap the climax, irresponsible charges of misconduct of affairs and misappropriation of funds have been circulated in the newspapers.

There is, of course, no truth in these spiteful and revengeful allegations, which grow out of the dismissal by Mr. Storms of two incompetent employees, who were appointed at the request of Governor Johnson. Mr. Storms' conduct is indorsed by the trustees of the State Mining Bureau, by the engineers who were instrumental in securing his appointment, and by the California Miners' Association.

The State of California ought to be ashamed of its treatment of its mining bureau, which is the organization representing the industry that made the state rich in the first place, ashamed of this scurvy treatment of Mr. Storms, and for that matter it ought to be ashamed of the inattention to the needs and interests of its mining industry itself, that has for a long time characterized the legislators who sit at Sacramento.

Our San Francisco correspondent has telegraphed us, under date of Jan. 22, that Governor Johnson has removed Mr. Storms and appointed F. M. Hamilton in his place. Moreover, that Mr. Storms is going to contest the removal.

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## South American Copper Mining

A striking feature of our copper statistics in recent years has been the predominant part that the United States has gradually been assuming in South American copper mining. It is within recent memory that South America was almost a *terra incognita,* insofar as people of the United States were concerned. We knew Peru as a country conquered by Pizarro, who robbed the treasures of some rulers called Incas, who were supposed to have secured the aforesaid treasure from the mines of Cerro de Pasco. And we knew that Chile furnished our agriculturists with sodium nitrate and exported some copper in a form known as "Chile bars" to smelters in Wales. This was about the extent of our knowledge.

Time has changed all of that, however, and now we are working for copper those self-same mines of Cerro de Pasco and smelting the ore with the aid of Dwight-Lloyd sinterers and basic converters; and in Chile we are working low-grade disseminated ore at the Braden mine by flotation and other new-fangled processes, and are getting ready to exploit Chuquicamata, which is supposed to possess the second largest copper deposit of the world (Butte being *hors concours*), and the stars and stripes waves and the eagle screams.

But seriously, let us look in detail at our own compilation of Chilean and Peruvian copper production in 1912. We arrived at the total for Peru in this way:

| Item | Pounds |
|---|---|
| Blister imported into U. S., 10 mos. | 40,000,000 |
| Blister imported into U. S., 2 mos. estd. | 8,000,000 |
| American smelters prod. fm. Peru ore | 9,725,216 |
| Peru imports into England, 11 mos. +est. for December | 2,900,000 |
| Sundries, estimated | 220,000 |
| Total | 60,845,216 |

For Chile we have the following figures:

| Item | Pounds |
|---|---|
| Bars cop. imptd. into U. S., 10 mos. | 6,000,000 |
| Bars imptd. into U. S., 2 mos. estd. | 1,200,000 |
| American smelters prod. fm. Chile ore | 22,572,444 |
| Chile imports into England and France to Dec. 15 | 48,036,800 |
| Chile imports into England and France 2 wks. estd. | 2,100,000 |
| Sundries, estimated | 220,000 |
| Total | 80,129,244 |

Thus the United States already smelts and refines nearly all of the copper of Peru and about three-eighths of that of Chile. Besides that, American smelters in 1912 produced about 3,500,000 lb. of copper from ore received from other South American countries, especially Bolivia and Venezuela. Our command of the South American copper market, already predominating, may become nearly complete when the Panama Canal affords better means of communication.

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## Mine Accidents in Montana

The report of the state mine inspector of Montana for the year ending Nov. 30, 1912, shows that the fatal accidents in that year were 47 in number, against 46 in the previous year. The number of men employed in 1912 was estimated as 14,500, against 14,000 in the previous year, the fatalities per 1000 men having been 3.21 and 3.28 respectively. For several years the fatality rate in Montana has been from 3 to 3.6. We doubt if too fine conclusions are to be drawn from variations in the decimals of these statistics, inasmuch as the total number of men employed apparently is not determined with accuracy. The same criticism may be made respecting most of the state statistics of this kind.

However, whether the divisor vary a little, plus or minus, and the quotient correspondingly, it may be assumed roughly that the fatality rate was about the same in the two years. This often happens, though different conditions prevail, on the theory perhaps that adversities average about the same.

Thus, in Montana in 1911 there were two bad single accidents. On Jan. 18 an explosion of powder in the Keating mine killed five men and injured two. On Sept. 3, six men were killed in the Black Rock mine, at Butte,

while riding on a cage loaded with drills. Both of these accidents belong to types constantly recurring and capable of avoidance by attention to, and enforcement of, the ordinary preventive laws and rules. In 1912 there was no single accident that killed more than two men and there were only two of them. Yet the total number of accidents, 47, was one more than in 1911.

In both years blasting accidents and falls of ground claimed the largest number of victims, as is almost always the case in American metal mining. In 1911 there were 11 fatalities from the former cause and 10 from the latter; in 1912 the numbers were four and 27 respectively. Of hoisting accidents there were 11 in 1911 and three in 1912. Of falls, otherwise than in hoisting, there were nine fatalities in 1911 and eight in 1912. The four classes of accidents here enumerated generally include the major portion of the annual death-roll, and probably have done so during the last 20 years.

Among the newer kinds of accidents we now find annually a certain number of deaths from electric shock (since electricity has been introduced underground); from poking ore chutes (since modern methods of handling ore have been adopted); and from trains of cars (since mechanical haulage has been practiced on a large scale).

The Montana record of mining accidents does not differ materially from that in the other Western States. If anything, the death rate is below the average, rather than above it. This may be explained by the fact that fully six-sevenths of the miners work in mines operated by big companies, which, as a rule, provide better safeguards and have better discipline than do small operators, leasers, etc. The classification of the four principal causes of accidents is, however, practically *prima facie* evidence that most mining accidents are ascribable to the carelessness of the men themselves.

❋

## Russian Mining Policy

The present attitude of the Russian government, as affecting foreigners in the mining industry, is somewhat unfavorable. First, there are the restrictions of the 100-*verst,* or 66-mile limit. This region is a belt along the east coast and southeast frontier of Siberia, and foreigners are not permitted to prospect or to mine there without permission of the governor of East Siberia. This is not easy to obtain. Then there is, in addition, a large region in East Siberia and South Siberia that is similarly closed to foreigners. The reasons are said to be strategic, though there is a strong party in Russia whose slogan is "Russia for Russians," and there is a tendency to restrict activities of foreigners and to encourage that of natives, although it is naïvely acknowledged that foreign capital is needed and is most welcome.

The policy of the government, in East Siberia, is said to be to drive out the Chinamen, who not only work in the mines, but also do most of the hard, dirty labor as well as the skilled work of all kinds. Thus, in Vladivostock, one sees Chinese teamsters, carpenters, masons, bricklayers. Russians, themselves, prefer to employ Chinamen to their own countrymen, for the Chinaman works quietly and fairly efficiently, while the Russian laborer is a surly, insubordinate, drunken trouble-maker, with a puerile mind and a strong body. Centuries of serfdom, with its concomitant degredations, are manifesting themselves in the attitude of the Russian laborer of the present day.

The policy of the Russian government is to protect the inefficient Russian laborers from competition and to compel his employment at the expense of the employer, though the Russian government itself employs Chinamen and Koreans in some of its departments.

The reason for driving out the Chinamen is seemingly strategic. The Korean, who is not a potential antagonist of the future, being thoroughly subjected by the Japanese, is not similarly harassed.

And all this is in view of the fact that the Russian government has been spending large sums in encouraging immigration into East Siberia and discouraging emigration from China. It has been urged that a policy of *laissez faire* in labor matters would be superior, for a country of such potentialities, and with so little labor to develop them, while there is China, overcrowded with cheap labor, immediately south.

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## Spelter in 1912

The publication by Henry R. Merton & Co., Ltd., of the statistics of the world's production of spelter in 1912 at so early a date as Jan. 11, 1913, is a feat that is worth mentioning. Of course, it goes without saying that the telegraph and cable were extensively used. Also it goes without saying that such prompt statistics are immensely more valuable than the tardy.

It appears that the world's production of spelter, which after a check in 1908 rose largely in 1909 and has been doing so annually since then, continued its upward course in 1912, the production in that year having been 956,335 tons (of 2240 lb.) against 881,305 in 1911.

The United States maintained in 1912 the premier position, which it has held since it passed Germany several years ago. If the zinc produced directly as oxide be included the United States has been the leading producing country for a great many years.

The spelter statistics for 1912 do not call for any special comment. All of the countries showed increases except Great Britain, where the output declined nearly 10,000 tons. It is noteworthy that the increasing production of spelter since 1908 has been coincident with an advancing market. This has created remarkable prosperity in the zinc business. During this period the marketing of the product has been managed by the international convention. The fact that there have been no such excesses, collapses, etc., as we have witnessed in copper is excellent testimony to the wisdom of the zinc selling agents.

❋

South America promises us large supplies of iron ore in the future. We have already referred to the development at the Imataca deposit in Venezuela, and to that promised in Brazil. Now the Panama Canal promises to make iron ore on the West Coast available and the Bethlehem Steel Co. has acquired control of deposits near Coquimbo, in Chile, where it is reported that exploration has shown a very large quantity—100,000,000 tons, it is said—of high-grade ore, within reach of a shipping port near Coquimbo. Preparations are being made to be ready to ship ore by time the canal is open.

## BY THE WAY

A facetious member of the staff of the New York *Sun* has asked why Mr. Untermyer, who is conducting the money-trust investigation for Mr. Pujo, does not put himself on the stand and ask himself to explain all the details of the Utah Copper-Boston Consolidated amalgamation.

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Conflagrations in United States in 1912 destroyed $207,543,900 of property value, or about $10,000,000 less than in 1911. No other country of the world can afford to burn up so much property, largely out of carelessness, as the United States. Miners and metallurgists are just as guilty in this as are other people.

❋

The isolation of an allotropic modification of hydrogen is reported to have been effected by Sir Joseph Thomson, director of the Cavendish Laboratories, at Cambridge. It bears the same relation to ordinary hydrogen that ozone does to oxygen, i. e., instead of $H_2$, it corresponds to the formula $H_3$, although it is said to be less active than ordinary hydrogen instead of more so, so much less that it is not explosive when mixed with oxygen. It has been extracted from meteorites and from metals exposed to the air for a long time, but efforts to produce it by synthesis have been failures. Since, according to the New York *Times*, the total quantity obtained is about one cubic millimeter, it is possible some of the above may have to be revised.

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The Rathenau medal, presented by the emperor of Germany to Dr. Emil Rathenau, was loaned, through the Allgemeine Electricitaets Gesellschaft, to the American Museum of Safety, for the purpose of awarding a replica each year to the inventor of the best device in the electrical industry for safeguarding life. The medal this year was awarded to Thomas A. Edison, for his improvement in the storage battery, which is regarded as reducing the danger to life and health of workers employed in mines, tunnels, submarine boats and other places where explosive gases generate. The *Scientific American* medal for the most efficient safety device exhibited at the museum, was awarded to the Draeger Oxygen Apparatus Co. for its pulmotor. The Travelers' Insurance Co.'s medal for the employer who has done most for the protection of its employees from death and accident, was awarded to the New York Edison Co.; the Louis Livingston Seaman medal was awarded to the National Cash Register Co., for the greatest progress in hygiene and sanitation and in the mitigation of occupational disease—presumably, also, for great advance in the safety of cash.

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Litigation has been the handmaiden of metallurgical patents, as well as of most others. This is especially true with regard to patents relating to the flotation of minerals. The expense of litigation and of experimental work in the early days of the process threatened to bankrupt nearly everyone in the business. This period was naturally followed by one of adjustment and consolidation. The chairman of Minerals Separation, Ltd., in referring to the subject of litigation at the last general meeting, said: "The Australian amalgamation has not only settled all actions in that country to which we were direct parties, but it has, I think, made it more difficult for anyone successfully to attack us or our Australian company; and it has, I believe, greatly strengthened our combination against would-be infringers. The action brought against James M. Hyde (a former employee of our American syndicate) for infringing our patents at the Butte & Superior mill, in Montana, U. S. A., has been and is being prosecuted with vigor; voluminous evidence has been taken both in the States and in London. I understand that all evidence in the case has been closed, and that the actual hearing by the Federal court, at Butte, Mont., will take place toward the end of January or early in February."

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To be popular for a few months is not a difficult accomplishment; however, to retain this popularity, and in addition the respect of one's employers and associates for a period of over 17 years, is an accomplishment requiring sterling qualities, this being exemplified in a recent occurrence at Anaconda. William Wraith, superintendent of the Washoe works of the Anaconda Copper Mining Co., was recently promoted to the position of manager of the International Smelting & Refining Co., at Salt Lake. Before leaving Anaconda, Mr. Wraith was called to the Washoe office on a pretext and presented with a magnificent chest of silver by the foremen and staff of the Washoe works, E. P. Mathewson making the presentation speech. Mr. Mathewson said in part: "I am called to make a few remarks, this afternoon, because accidentally a pretty good man, who has been around here for the past 17 years, giving his best services to the Anaconda Copper Mining Co., and to its subsidiary plants, has finally had his merit, which we all knew, recognized by his employers and has been recommended to a much better job at a much better salary with good people—I will not admit that there are better. Our good friend here, William Wraith, has been square in all his dealings with us; we have all liked him. He has been doing his own work and mine, too, year after year, without complaint. I know you will all agree with me in saying he is a very good fellow, and we wanted to make some kind of a demonstration to show him how we felt toward him. . . ." Mr. Wraith, in thanking his friends, referred to the "Washoe school of metallurgy," from which so many metallurgists have gone forth, and to its "head master." He said: "The Washoe smeltery is certainly the best school on earth and it is headed by the best teacher. (Applause.) I am glad to acknowledge that I am a product of that school; I am glad to acknowledge Mr. Mathewson as my teacher. I hope in my dealings with men never to do other than what his example has shown. I thank you, indeed, for this remembrance. . . . I want to say that I spent one of the hardest days of my life today, in bidding good-bye to the men with whom I have been so long associated." The chest presented to Mr. Wraith contained 150 beautiful examples of the silversmith's art, fashioned in the Irving pattern. On the chest there is a silver plate, on which the following is engraved: "William Wraith, from foremen and office force, Washoe Reduction Works, Anaconda, Mont., 12-27-12."

## Bethlehem Steel Buys Chile Iron Mines

Charles M. Schwab is responsible for the statement that the Bethlehem Steel Co. has purchased the Tofo iron-ore deposits of Chile from the French *concessionaires*. The Panama Canal, according to Mr. Schwab, made possible the acquisition of these deposits. It is purposed to build a fleet of not less than ten 15,000 to 20,000-ton steamers to bring the ore, *via* Panama, to the Bethlehem plant, where the ore consumption, in the last five years, has jumped from 300,000 to 1,500,000 tons per annum.

These deposits, which are now being worked, are situated near the bay of Cruz Grande, in the province of Coquimbo, Chile. The broken ore is transported on a Decauville railway to the central station of an aërial ropeway (Pohlig system) 7.2 km. long, connecting with Cruz Grande, the present ropeway having a capacity of 40 tons per hour. A quay with a 35-m. bridge has been built in Cruz Grande harbor, which allows vessels to receive their cargo direct by chute, present loading capacity being 1000 tons per diem. The bay is well protected from northern and southern winds, but is still open to the west. The aërial ropeway, it is understood, is already being doubled by the Société des Hauts-Fourneaux du Chile, but it is evident that it must be still further increased to supply the Bethlehem Steel Works, as the present capacity of the entire installation, allowing for breakdowns, bad weather, etc., is estimated at only 250,000 tons per annum.

To work the mines the Bethlehem-Chile Iron Mines Co. has been incorporated in Delaware, with a capital stock of $4,000,000, while to provide for the ore steamers, the company will issue between $5,000,000 and $7,000,000 in 5% bonds. This financing, it is understood, will be done mainly by the foreign bankers who are associated with Mr. Schwab.

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## Traffic of the Sault Ste. Marie Canals

The reports of the superintendents of the canals at the Sault Ste. Marie for the season of 1912, show that 22,778 vessels passed through the canals during the season, carrying 72,472,676 short tons of freight; 18,995,460 tons more than in 1911, and 10,109,458 tons more than in 1910. The movement was divided between the two canals as follows:

| | U.S. Canal | Canadian Canal | Total |
|---|---|---|---|
| Vessel passages | 14,916 | 7,862 | 22,778 |
| Tons freight | 32,824,815 | 39,647,861 | 72,472,676 |
| Av. cargo, tons | 2,201 | 5,043 | 3,226 |

The mineral freights included in the total were as follows, in short tons, except salt, which is given in barrels:

| | 1911 | 1912 | Changes |
|---|---|---|---|
| Coal | 15,332,876 | 14,931,594 | D. 401,282 |
| Iron ore | 30,731,235 | 46,303,423 | I. 15,572,188 |
| Pig and manufactured iron | 412,269 | 654,892 | I. 242,623 |
| Copper | 132,481 | 116,954 | D. 15,527 |
| Building stone | 5,342 | 2,282 | D. 3,060 |
| Salt, bbl | 661,308 | 660,991 | D. 317 |

Coal was 20.6%, and iron ore 63.9% of the total freight in 1912. Iron ore was the largest item of East-bound freight, and coal of West-bound tonnage.

To illustrate some points in the Lake trade, the records of the Pittsburgh Steamship Co., whose fleet is of the larger class of vessels, carrying iron ore and coal, show the following averages for the season of 1912: Stay in lower ports, 20 hr. 9 min.; in upper ports, 11 hr. 51 min.; total time in port per round trip, 32 hr. The average cargo carried was 6796 tons; the largest cargo, 13,007 tons. The fastest loading record for iron ore was 10,325 tons in 2 hr. 30 min., which is 4130 tons per hour.

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## Canadian Mining Institute

The secretary announces that the fifteenth annual general meeting will be held in the City of Ottawa, Mar. 5-7. Headquarters will be at the Chateau Laurier. Among the papers already promised for the meeting are:

"Mining Methods as at Present Employed in the Yukon," by Dr. H. M. Payne, New York.

"The Evolution of Gold Metallurgy," by R. B. Lamb, Toronto.

"Grinding Analyses and Their Application to Cyanidation, Classification, Etc.," by John W. Bell, McGill University, Montreal.

"Some Notes on the Geology of the Pearl Lake Section of the Porcupine District," by H. G. Skavlem, Aura Lake, Ont.

"Monel Metal," by Dr. W. Campbell, Columbia University, New York.

"Recent Metallurgical Developments," by Dr. Alfred Stansfield, McGill University, Montreal.

"The Steel Industry of Nova Scotia," by Thomas Cantley, New Glasgow, N. S.

"The Iron Resources of Quebec," by Prof. E. Dulieux, Ecole Polytechnique, Montreal.

"The Agglomeration of Iron Ores," by N. V. Hansell, New York.

"Prospecting the Iron Sands of Natashkwan, Que., with the Empire Drill," by G. C. Mackenzie, Department of Mines, Ottawa.

"Mica Mining in Canada," by Hugh de Schmid, Department of Mines, Ottawa.

"Mica Manufacturing and Marketing," by S. O. Fillion, Ottawa.

"The Origin of Graphite," by John Stansfield, McGill University, Montreal.

"The Clay Resources of Western Canada," by Dr. Heinrich Ries, Cornell University, Ithaca, N. Y.

"The Utilization of Exhaust Steam," by J. M. Gordon, Montreal.

"State Aid to Mining in Australasia," by H. Mortimer-Lamb, Montreal.

"The Evolution of Mining and Milling," by J. J. Penhale, Sherbrooke.

"The Use of Rescue Apparatus in Metal Mines," by H. E. Bertling, Toronto.

"Gold and Placer Mining," by W. J. Dick, Ottawa.

"The Best Methods of Mining Coal under Various Conditions," by Alexander Sharp, Vancouver.

"Core Drilling," by P. H. Moore, Toronto.

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## Spelter Production of the World

Messrs. Henry R. Merton & Co., of London, estimate as below the spelter production of the world in 1912 and preceding years. The figures are in long tons:

SPELTER PRODUCTION OF THE WORLD

| | 1910 | 1911 | 1912 |
|---|---|---|---|
| Belgium | 169,860 | 192,020 | 197,045 |
| Holland | 20,645 | 22,375 | 23,555 |
| Germany, East | 138,040 | 153,715 | 166,425 |
| Germany, West | 86,120 | 92,735 | 100,370 |
| Great Britain | 62,085 | 65,900 | 56,330 |
| France and Spain | 58,210 | 63,210 | 70,930 |
| Austria and Italy | 13,095 | 16,610 | 18,795 |
| Poland | 8,495 | 9,780 | 11,000 |
| Total Europe | 556,550 | 616,345 | 644,450 |
| Australia | 500 | 1,700 | 2,260 |
| United States | 246,680 | 263,260 | 309,625 |
| Total | 803,730 | 881,305 | 956,335 |

The production of the United States was 30.7% of the total in 1910; 29.9% in 1911, and 32.4% in 1912. The total increase in 1912 was 75,030 tons, or 8.5%, over 1911, and 152,605 tons, or 19%, over 1910. Great Britain was the only producer which showed a decrease last year.

## PERSONALS

James Fitch, of Tacoma, Wash., is visiting New York.

J. Nelson Nevius, of Pasadena, Calif., is visiting New York.

Kirby Thomas, of New York, is in Ontario on professional business.

B. B. Thayer went to Butte on Jan. 18, for a periodic tour of inspection of the Anaconda properties.

J. Parke Channing has gone to Arizona. He expects to return to New York about the end of February.

Fred. Smith has resigned his position as manager of the Mohawk and Wolverine mines in Michigan, on account of ill health.

John Seward, of New York, has gone to Virginia to examine a deposit of pyrites, and will return about the end of January.

Leighton Stewart, recently at Santa Barbara, Chihuahua, is now with the Cusi Mining Co. at Cusihuiriachic, Chihuahua, Mexico.

Arthur E. Roberts is requested to send his address to this "Journal," as a friend wishes to communicate with him on important business.

Oscar Lachmund has been appointed general manager of the British Columbia Copper Co., with headquarters at Greenwood, B. C., and is now in charge.

J. I. Hoffmann has retired from the firm of Johnson & Hoffmann, mining engineers, London. The business of the firm will be carried under the style of H. H. Johnson & Co. hereafter.

George E. Farish is for the winter representing the John McMartin and allied interests in British Columbia, with headquarters at Nelson, B. C. He is also general manager of the Motherlode mine at Sheep Creek.

J. Laurence Ferguson, who recently opened an office in the First National Bank Building, Denver, Colo., has been appointed consulting engineer for the Triangle Mining & Development Co., of Missoula, Montana.

George Shroter left New York last week for Sonora, where he will be engaged for several months in the inspection of the Animas mine at San Javier and in the examination of several other properties in that vicinity.

O. R. Hamilton, Iron River, Wis., has been appointed special engineer to assist the tax commission and the state geological survey in making the appraisal of the mining properties of Wisconsin, by State Geologist Allen.

Charles Biesel, formerly manager of the Dolores mine, has been appointed general manager of the Mines Company of America, with headquarters at El Paso, Texas; H. G. Palsgrove, formerly manager at La Dura, is now manager at Dolores.

E. G. Spilsbury left New York, Jan. 19, for Houston, Texas, to begin the laying out of the work for the proposed new blast furnaces and openhearth plant of the Southwestern Steel Corporation. He expects to be in Texas for a couple of months.

W. S. Keith, formerly superintendent of the Helester Gold Mining Co. at Lowle, and the Frankmont Mining Co. at Last Chance, has taken a position with the Pacific Gas & Electric Co. on the construction of their Hydro-electric power plant on Bear River, California.

G. W. Hewitt, a graduate of the University of Wisconsin, has been appointed manager of the blast furnace department of the Riverside works of the National Tube Co., at Benwood, W. Va., to succeed Clarence Underwood, who is now identified with the Gary plant of the Steel Corporation.

Prof. Wm. Nicol, of the Queen's School of Mining, Kingston, Ont., leaves shortly for Germany to attend the anniversary celebration in honor of Prof. Victor Goldschmidt, head of the Mineralogy Department of Heidelberg University. Prof. Nicol has been delegated by two American universities to present a trophy to Prof. Goldschmidt.

Theodore Dengler has been appointed general manager of the Wolverine and Mohawk properties, succeeding Fred Smith, resigned. Mr. Dengler has been connected with the Stanton interests since 1893, and his appointment is in the nature of a promotion for efficient service. He has been in charge of the Atlantic property for a number of years.

H. B. Pickings, deputy inspector of mines for Nova Scotia, announces that he has severed his connection with the Nova Scotia Department of Mines, and that he has taken an office in the Metropole Building, Halifax, where he is prepared to undertake general mining engineering practice, particularly in connection with the metalliferous mines and deposits of Nova Scotia.

W. E. Hartman, who until recently was managing engineer for the H. Koppers Co., Chicago, has been retained as consulting engineer by the Republic Iron & Steel Co., Youngstown, O., in connection with the construction of 68 Koppers byproduct coke ovens. Mr. Hartman also has been retained by the Gas Machinery Co., Cleveland, to take care of its coke department.

John Howe Hall, formerly with the Bethlehem Steel Co., and for the past six years metallographist and metallurgist in charge of the research department of what is now the Taylor-Wharton Iron & Steel Co., has severed his active connection with the latter company, having completed the installation of metallographic and testing equipment under the direction of Prof. H. M. Howe, vice-president and consulting engineer.

## OBITUARY

Walter Scott Adams, formerly of Boston, died Jan. 18 at Biltmore, N. C. He was president of the Consolidated Nickel Mining Co. and of the North Carolina Mining Co. for several years.

Loyal S. Nye died at Binghamton, N. Y., Jan. 12, aged 77 years. He was born in Missouri and went to Colorado many years ago. He organized and managed the Nye Forwarding & Transportation Co. at Denver, which was an important concern until the railroads reached Colorado. Later he engaged in mining and was one of the early operators in the Deadwood district of South Dakota. About 1892 he retired, but had since done some work in promoting mining enterprises.

James W. Carter died at Kingman, Ari., Dec. 22, aged 57 years. He was born in Missouri, but had lived in Mohave County, Ari., over 25 years. He located the mines now held by the Carter Gold Mines Company of which company he was the nominal head at the time of his death. He also discovered the value of the water passing through the tailings pits of the Gold Road mines and with Henry Lovin obtained a lease on these pits. It is understood that the profits from this lease were considerable. It is probable, however, that the initial cause of Mr. Carter's fatal illness was the dust inhaled while working the tailings of the Gold Road and Tom Reed mines and gathering the crusts from the surfaces of the pits.

## SOCIETIES

**Northwest Mining Convention**—Feb. 19 to 21, inclusive, have been selected as the dates for the second annual convention, to be held in Spokane. Invitations will be sent to the American Institute of Mining Engineers, the electrical and chemical engineers' organizations, the societies of civil and mechanical engineers, and others. The Pacific northwestern states and the western Canadian provinces constitute the territory to be represented in the convention.

**American Institute of Consulting Engineers**—The annual meeting of the Institute was held Jan. 14, 1913 at the Engineers' Club, New York. Henry Holgate, of Montreal; Daniel E. Moran, of New York, and Charles Sooysmith, of New York, were elected members of Council to serve three years, and F. A. Molitor, of New York a member of council to serve one year. After the routine business of the meeting was transacted, Prof. George F. Swain, of Harvard addressed the meeting on the question of "Education," which was ably discussed by Rudolph Hering, Gen. T. A. Bingham, Prof. Gardner S. Williams, of Ann Arbor, Mich., and Frank J. Sprague.

**Mining and Metallurgical Society**—The annual meeting was held in New York on Jan. 14, with two sessions, one in the afternoon and one in the evening, both being well attended. The afternoon session was devoted to business. The election of the following officers for 1913 was announced: H. M. Chance, president; J. R. Finlay, vice-president; W. R. Ingalls, secretary; R. A. F. Penrose, Jr., S. W.

Mudd, C. W. Goodale and H. S. Munroe, councillors. In the evening session, Messrs. J. Parke Channing, D. M. Riordan, T. H. Leggett and W. R. Ingalls were the speakers.

**Verein Deutscher Eisenhüttenleute**—At the annual meeting in Düsseldorf, Germany, early in December, the chairman, Dr. Springorum, reported that the membership of the society has now risen to 5400. He called attention to the big increase in Germany's pig-iron production this year and said that the October make was at the rate of 19,000,000 tons a year. The proposal to introduce legislation to establish the eight-hour work day in industrial concerns called forth the remark from one speaker that this would necessitate the employment of 80,000 additional laborers in the iron trade, and he denied that this number could be found, either at home or abroad.

**University of Washington**—The short mining session annually held at the College of Mines, University of Washington, will begin on Jan. 7, 1913, and continue for three months. This course of instruction in mining, metallurgy and related subjects is open to everybody without any restrictions in regard to previous training or experience. To the prospector who wishes to learn something of chemistry, assaying and milling by means of laboratory instruction or to the business man who wishes to gain a general idea of mining by means of lectures and classroom work, this opportunity to spend three months in the laboratories of the university is now offered. The work is arranged to suit the needs of the individual. The subjects offered are ore mining, placer mining, coal mining, milling, assaying, surveying, chemistry, geology, mineralogy, metallurgy, mining law, forging, mine timber framing. As a rule, students in the short session pick out a group of related subjects and follow this arrangement for one year, then frequently return for a second term's work along special lines suggested by their previous experience. The aim is always to help the individual.

**Utah Society of Engineers**—At the meeting held Jan. 17, an address on the "Geology of the Utah Oilfields" was given by Prof. F. J. Pack, of the University of Utah. According to Prof. Pack, the promising fields of the state have not yet been given intelligent and systematic development. The Vernal, San Juan, and Green River fields were taken up and discussed. In the Vernal field there is one of the greatest series of oil shales to be found anywhere in the country. Most of the work up to date has been done in the San Juan region, where prospecting has been carried on in shallow zones whose usefulness has been steadily reduced, through the seepages of past ages, owing to the deeply dissected country cut by the cañons of the San Juan and other rivers. Utah has almost unlimited resources in coal, and nearly all forms of hydro-carbons, including ozokerite, gilsonite, etc., and there is reason to believe that oil also will be found in notable quantities. Following Prof. Pack's talk a paper on "Petroleum, Crude Oils, and Their Refining Value" was given by J. C. Howard, president of the Utah Oil Refining Co. The engineers were invited to visit the plant of the Utah Oil Refining Co. in North Salt Lake.

## BUSINESS NOTES

The Bucyrus Co., manufacturer of excavating machinery, has changed its New York office to 30 Church St., with C. S. Reed, Eastern sales manager, in charge.

George P. Flinn, representative of Ernst Wiener Co., of New York, designers and builders of Wiener industrial railways, now has his office at 201 Devonshire St., Boston, Massachusetts.

The Hardinge Conical Mill Co., of New York, has recently received an order for two 8-ft. Hardinge conical pebble mills from the Butte & Superior Copper Co. of Butte, Mont.; also for three mills of the same size for the new plant of the Commonwealth Mining & Milling Co., of Pearce, Arizona.

The Epping-Carpenter Co., Pittsburgh, Penn., manufacturer of pumping machinery, has opened a branch office at 728 Monadnock Building, Chicago, Ill., in charge of R. E. Burke, and a Boston office at 131 State St., in charge of James J. Hart; both men were formerly connected with the International Steam Pump Company.

The H. W. Johns-Manville Co., manufacturer of packing, pipe covering, roofing, etc., has recently completed a new factory at Manville, N. J. This plant consists of nine buildings. Each building has an average length of 1000 ft. The combined floor area is about one million square feet. The tract consists of 320 acres. The company's private railroad system comprises five miles of track and connects directly with the Central Railroad of New Jersey, the Lehigh Valley and the Philadelphia & Reading R.R.; about 3000 men will be employed in this plant.

The Wheeler Condenser & Engineering Co., Carteret, N. J., has acquired the American license to build turbo air pumps of the A. E. G. type as manufactured in Europe by the Allgemeine Electricitaets Gesellschaft. This air pump is of the rotary water jet type, for motor or steam turbine drive, air being removed from the condenser by ejector action of a series of small water jets and also by positive entrapment of air between successive small slugs of water. A number of these pumps are now under construction at the works of the Wheeler Condenser & Engineering Company.

## NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

DRILL—Internal-combustion Percussive Machine. Lewis L. Scott, Joplin, Mo., assignor to Scott Drill Co., St. Louis, Mo. (U. S. No. 1,049,276; Dec. 31, 1912.)

CONCENTRATOR—Frederick M. Atkinson, Chicago, Ill. (U. S. No. 1,049,035; Dec. 31, 1912.)

SHAFT LINING—Tubbing for Shafts. Wilhelm Breil, Bredeney, Essen-on-the-Ruhr, Germany. U. S. No. 1,048,287; Dec. 24, 1912.)

ROASTING—Improvements in or Relating to Agitating or Stirring Devices for Use in Mechanical Roasting Furnaces. M. van Marcke, Cologne, Germany. (Brit. No. 13,550 of 1912.)

ROASTING—Improvements in or Relating to Mechanical Roasting Furnaces. Metallbank und Metallurgische Gesellschaft Aktiengesellschaft, Frankfort-on-Main, Germany. (Brit. No. 16,346 of 1912.)

SULPHIDE ORES—Improvements in or Relating to the Treatment of Sulphide Ores or Metal-Bearing Solutions and the Production of Ammonia or Ammonium Salts or other Nitrogenous Compounds. E. A. Ashcroft, Sande Gaard, Sogn, Norway. (Brit. No. 25,506 of 1911.)

CYANIDING—Process of Precipitating Materials from Solutions. Daniel Bosqui, Monahan, Wash., assignor to Merrill Metallurgical Co. (U. S. No. 1,049,560; Jan. 7, 1913.)

EXTRACTION—Improvements in Processes for Extracting Metals from Ores. H. S. Mackay, Riverside, Calif. (Brit. Nos. 27,343; 27,344; 27,345 and 27,342 of 1911.)

GOLD-SAVING MACHINE. Robert Smith Bassett, Minneapolis, Minn., assignor to Ocean Beach Gold Platinum Dredge Co. (U. S. No. 1,050,598; Jan. 14, 1913.)

ORE TREATMENT—Process of Treating Metal and Mineral-bearing Materials. John L. Malm, Denver, Colo. (U. S. No. 1,049,746; Jan. 7, 1913.)

PLACER MINING—Means for Separating Minerals from Alluvial Wash. Rees Hughes, Wilson's Downfal', N. S. W., Australia. (U. S. No. 1,048,171; Dec. 24, 1912.)

BRIQUETTING—Method of Briquetting Flue Dust. George L. Collard, Sharon, Penn. (U. S. No. 1,047,174; Dec. 17, 1912.)

ELECTRIC FURNACES—Improvements in Electric Furnaces. E. Stassano, Turin, Italy. (Brit. No. 21,281 of 1912.)

IRON METALLURGY—Improved Process for the Elimination and Recovery of Arsenic, Antimony, Copper, Lead, Zinc, Sulphur and Like Undesirable Constituents of Ores and Products Used in the Extraction of Iron Spiegeleisen and Other Iron-Manganese Products. C. A. Brackelsberg, Stockum, Germany. (Brit. No. 27,451 of 1911.)

SMELTING—Process of Hydro-electric Smelting of Iron Ores. Antonio Tommasini, New York, N. Y., assignor of one-half to Marcellus E. Thornton, Hickory, N. C. (U. S. No. 1,050,255; Jan. 14, 1913.)

SMELTING FURNACE—Hydro-electric Smelting Furnace for Iron Ores. Antonio Tommasini, New York, N. Y., assignor of one-half to Marcellus E. Thornton, Hickory, N. C. (U. S. No. 1,048,603; Dec. 31, 1912.)

TIN—Improvements in or Relating to the Dressing of Tin-bearing Ores and the Like. H. Bailey, Ilford, Eng. (Brit. No. 18,490 of 1912.)

VANADIUM—Process of Extracting Vanadic Acid from Insoluble Copper Vanadate. Warren F. Bleecker, Boulder, Colo., assignor, by mesne assignments, to the Rare Metals Mining & Milling Co. (U. S. No. 1,049,330; Jan. 7, 1913.)

ZINC FURNACE. Alexandre Folliet, Brussels, Belgium. (U. S. No. 1,049,570; Jan. 7, 1913.)

ORE DOCK. Max Toltz, St. Paul, Minn. (U. S. No. 1,050,357; Jan. 14, 1913.)

PROPS—Device for Propping Mines. Friedrich Nellen, Essen-on-the-Ruhr, Germany. (U. S. No. 1,049,135; Dec. 31, 1912.)

CRUSHING—Hopper for Crushing and Grinding Rolls. Enos A. Wall, Salt Lake City, Utah. (U. S. No. 1,050,183; Jan. 14, 1912.)

ELECTRIC-FURNACE LINING. Frederick M. Becket, Niagara Falls, N. Y., assignor to Electro Metallurgical Co., Niagara Falls, N. Y. (U. S. No. 1,049,801; Jan. 7, 1913.)

ELECTROLYTIC REFINING—Process of Treating the Anode Mud Resulting from Electrolytic Refining of Lead and Copper. Harry Wehrlin, Steglitz, near Berlin, Germany. (U. S. No. 1,049,013; Dec. 31, 1912.)

# EDITORIAL CORRESPONDENCE

### SAN FRANCISCO—Jan. 15

**The Controversy over Searles Lake Potash** and other deposits in San Bernardino County is wholly a legal dispute that has not extended beyond the courts. There has been no battle nor near-battle between hired gunmen, no prowling detectives, no U. S. deputy marshalls skirmishing over the desert. Some of the parties to the controversy have evidently enjoyed being made the subjects of untrue, sensational and ridiculous newspaper stories; others have not. The California Trona Co. is owner of the Searles Lake properties. The Foreign Mines Development Co. holds a mortgage on the properties. A suit was brought against the two companies and others interested by six stockholders of the California Trona Co.; R. B. Phillips, Harry McLaughlin, E. H. Merrill, William B. Cookson, C. E. Dolbear and E. I. Bartholomew. The plaintiffs charge that the owning corporation and the mortgagee and Charles W. Slack, E. J. Boyes, F. J. Hanus, Guy Wilkinson and others have caused the sale of the properties to the Foreign Mines Development Co. and have permitted them to be taken over on the mortgage. The specific demands were for $500,000 damages, and conspiracy was alleged. The original complaint was filed in June, 1911, and has been twice amended. The third demurrer was sustained by the superior court in Alameda County, Jan. 10, 1913, and 30 days is allowed for filing the third amended complaint. The annual meeting of the stockholders of the California Trona Co. was held Jan. 10. Dr. E. J. Boyes, president, having sold his interests, resigned. The following new board of directors was elected: Guy Wilkinson, American representative of Foreign Mines Development Co. of London; Mat Schmulowitz, J. K. Hutchinson, Perry Evans, of San Francisco; C. W. Wilkinson, of Berkeley. Since the filing of the second amended complaint on Dec. 20, 1912, there has been some talk of supposed German interests said to be represented by Henry H. Lee, attorney, of San Francisco, purposing to jump the mining claims on Searles Lake in case a legal loophole could be found in the court proceedings or failure on the part of the owning corporation to do the annual assessment work; and that was the basis of the story of an expected war of hired gunmen on the desert.

**The California Miners Association** has appointed three committees through W. C. Ralston, president, pursuant to a resolution adopted by the annual convention in December. They are composed as follows: Executive—B. M. Newcomb, C. M. Belshaw, E. C. Voorhies, Edward H. Benjamin, S. B. Christy, Louis Rosenfeld, Newton Cleaveland; legislative—E. C. Voorhies, C. H. Dunton, Wakefield Baker, Charles M. Belshaw, John R. Tyrrell, E. B. Braden, F. W. Bradley, Frank R. Wehe, E. C. Hutchinson, Newton Cleaveland, H. Foster Bain, Harold T. Power; hydraulic mining—W. W. Waggoner, A. A. Tregidgo, Harold T. Power, Russell L. Dunn, W. F. Englebright. The committee on legislation will look after the introduction of initial measures in the present session of the legislature and endeavor to prevent the enactment of laws inimical to the mining industry, and there is apparently as great need for the watchful performance of the latter duty as for the active labor necessary for the framing and passage of bills of value to mines and miners. A proposition will be made by the hydraulic mining committee to the state débris commission looking to the ultimate resumption of hydraulic mining in such districts where it is now prohibited. A plan will be submitted which contemplates the impounding of tailings and the construction of reservoirs that will not only aid in the withholding of débris from the streams but serve in the conservation of water. The accomplishment of the undertaking will require some new or amended legislation. One of the essential duties of the legislative committee will be to prevent the enactment of laws that would work permanent hardship upon the copper smelters and the dredge operators.

### DENVER—Jan. 17

**A "Blue Sky" Law,** a bill similar to the law of Kansas, to regulate the sale of stocks and bonds and supervise other investments and companies and their agents in Colorado, was suggested by Governor Ammons in his inaugural address, Jan. 14, and later in his message to the legislative bodies of the state now in session at Denver. Every company whether a home or foreign company doing business in Colorado must submit a statement on forms furnished by the commission, stating the property, situation, assets, liabilities, the names of its officers, what commission is paid to agents, salary of officers, and amount of office furniture, etc. The bill also provides for an examiner to examine the property or business of the company at a fee of $10 per day and expenses, payable by the company making application. No company may do business or offer stocks or bonds for sale in this state that has not received a certificate from the commission. A fee of $10 is charged the company making application and a license fee for each agent of the company of $5. For attempting to do business in this state without a license there is to be a fine from $100 to $1000 and a jail sentence. This is a summary of the bill now introduced in the House of Representatives, known as House Bill 37.

**The National Public Lands and Water League** is scheduled to be organized at a final meeting of Colorado mining men. The organization will attempt, chiefly by legislation, to reform the United States land laws as they now exist. Colorado congressmen, members of the legislature and members of the Denver chamber of commerce and prominent business men of the state are instrumental in the organization of the league. Briefly, the objects of the organization are as follows: To secure the just administration of existing laws relating to public lands and water; to secure the elimination from the national forest reserves of all lands above timber line that are now included in the reserves; to cause to be restored to the prospector his right to patent his claim according to existing laws, and to secure the reversal of the arbitrary rulings of the Secretary of the Interior contrary to the acts of Congress and the decisions of the courts; to secure the abandonment of the government policy of leasing public lands; to secure legislation relating to the locating of oil lands under the placer mining act, and to remove government forestry officials from politics while in office.

**The Zinc and Lead Industry of Colorado** was represented by Gen. George W. Cook, of Denver, who testified before the tariff commission at Washington, D. C., that if lead and zinc were placed on the free list more than 150 producing mines and concentrating mills in 22 states would close down. Leadville alone would be affected to the amount of nearly $2,000,000, and as by a recent ruling of the Interstate Commerce Commission the freight rate to Oklahoma and Kansas was raised on zinc and lead ores and concentrates, the prevailing prices that these metals command cannot stand much of a reduction.

**The Water Level in the Cripple Creek District** has fallen from 200 ft. in some mines to 242 in others. The flow from the portal on Jan. 3 was 8485 gal. The fall in December was almost 30 ft., making the total subsidence in the Gold Coin shaft 218 ft. At the Elkton the decline was 11 feet from Nov. 26 to Dec. 26, the total subsidence up to the last date being 242 ft. At the Independence the total recession on Dec. 15 was 206 ft., with a fall of 10 ft. in the month preceding. Measurements in various mines, according to the report show an average fall in the western section of from 20 to 30 ft. more than in the Battle Mountain district.

### SALT LAKE CITY—Jan. 18

**Statistics of the Cost of Production of Lead** are being collected by the Utah producers for the purpose of helping retain the present tariff on this metal. These statistics will be used before Congress to demonstrate the need of protection for the lead industry of the state. The Daly-Judge company of Park City has recently furnished statistics on its cost of production, covering a period of nine years, from 1903 to 1911 inclusive. This company produces lead, silver, and zinc, but is chiefly a lead producer. During the period mentioned the average cost of production was $4.13 per 100 lb., and the average selling price, $4.58, leaving a profit of 45c. The Daly-Judge is a good example of a Utah lead producer, operating on modern lines. During the nine years mentioned, the company has produced a total of 70,735,390 lb. of lead.

**The Legislative Appropriation Bill** reported to the Senate, Jan. 13, contained provisions for continuing the assay offices

omitted from the bill, when it passed the House. This provides for the assay offices at Salt Lake City. The Senate adopted the amendments, Jan. 15. The Salt Lake office serves a large mining district, of which this city is the center, and enables owners of bullion to receive prompt returns, which would not be the case, if they were obliged to ship to other offices. The territory served includes Utah, parts of Idaho, Wyoming, Montana, Nevada and Arizona, drawing from those sections which have direct railroad connection with Salt Lake City.

**Unusually Cold Weather** for Utah has been experienced in the last two weeks. Operations at some of the Bingham properties and mills have been interfered with for several days by the extreme cold. There have been several snowslides at Park City. A slide near the Daly-Judge tunnel, Jan. 17, covered two men and a four-horse team and ore sleigh. This slide came from the east side of the cañon past the American Flag mine, and completely buried the men and team. The men were dug out at once by the top men at the Daly-Judge, without serious injury, but one of the horses was killed.

### NEGAUNEE—Jan. 18

**The Michigan State Tax Commission** has become involved in an altercation with the Taxpayers Association of Crystal Falls over certain valuations in Mastodon township where large bodies of iron ore have recently been discovered. A principle is involved as to how land should be valued which lies next to a proved ore deposit, the tax commission having given such land a nominal value of only $10 or $20 per acre, while the local people contend that it is worth much more if only for surface rights. When ore is discovered the popular impression usually is that the entire vicinity should jump into a boom stage; and interested parties conceive plans for townsites, railroads, etc. The tax commission, on the other hand, holds the valuable ore formation strictly to proved areas as advised by its experts, and makes little effort to raise assessments on near-by unexplored lands. It will be recalled that J. R. Finlay in his appraisal of Michigan mines did not assess unexplored mineral lands for mineral value, his remarks on the subject being as follows: "Such lands are undoubtedly valuable but we have not succeeded in finding any logical measure of their value." The controversy in the Crystal Falls district was briefly as follows: Four descriptions were assessed by the local supervisor last summer at $33,500; $33,500; $144,000; and $144,000, respectively. In the autumn the tax commission reviewed the assessments in a series of sittings on the iron ranges at which its technical advisers were present. Of the two descriptions assessed at $33,500 each, the commission placed a value of $135,000 on one 80-acre tract, and assessed the rest at only a few hundred dollars, its former value as land, giving it no value for mineral possibilities, and assuming no boom conditions such as for prospective mine locations, roads, dumping grounds, etc. The commission agreed that if a quarter section of land, 160 acres, was proved to have valuable iron ore, and the explorations are situated on 40 acres only, the 40 acres alone should be taxed for the ore deposits and not the entire 160 acres. In the case of the two descriptions assessed at $144,000 each, the commission placed an assessment of $303,400 on one 40-acre tract and valued the rest at a small nominal figure. It is an object of the taxpayers' association to keep assessments on the homes and real estate as small as possible, rather making the mining companies pay the bulk of the taxes. The mining companies for their part have strenuously objected to the radical increased valuations of their orebodies resulting from the Finlay appraisal. It is evident, however, that in the case of the four descriptions cited above, the tax commission raised the total valuation from $355,000 to $439,000. The apparent discrepancies claimed by the taxpayers' association, whereby a 40-acre tract is assessed at several hundred thousand dollars while the adjacent forty is assessed at only a few hundred dollars, are due to the policy of retaining unexplored territory at its old land value, which is usually low, rather than raising the assessment because near-by land contains valuable orebodies.

**The Weekly Payment of Employees,** which it is proposed to enforce by legislation has aroused considerable discussion. The present practice in the iron region is to pay monthly, usually about the 15th or 20th, for the preceding month. Mining men oppose weekly pay rolls because of the contract system of mining in which miners are given monthly contracts at so much per foot of drift or so much per car of ore. The computation and letting of contracts takes so much time, and a miner's progress drifting for a week may be so little, that weekly contracts would probably be unpopular in practice.

### DEADWOOD—Jan. 16

**An Investigation of Some Gold Discoveries** near Kadoka, S. D., in the plains east of the Black Hills, was recently made by Elwood C. Perisho, dean of the College of Arts and Sciences of the State University, at the request of residents of the district. He reports finding a thin streak of sand carrying placer gold, in some cases in good quantity, but gives it as his opinion that the deposit is too thin to pay for working. He believes that the gold originally came from the Black Hills, when that region was drained by White River, instead of the Cheyenne, as at present. He says: "The gold was washed down the steam beds and this will also account for the presence of gold in abandoned channels in the Missouri River." Gold has been identified at a number of places in South Dakota, but outside of the Black Hills there are at present no commercial deposits.

### TORONTO—Jan. 17

**The Net Earnings of the Lake Superior Corporation** for November increased nearly 200% over the corresponding period of the previous year, and from July 1 to Nov. 30, 1912, there was a gain of over 50%. The numerous extensions and improvements which have been carried out through the work of the Algoma Steel Corporation, are now being reflected in the operation of the company and in addition to this, the current year should show a considerable increase in revenue from the Algoma Central and the Algoma Eastern Railways. The Lake Superior Corporation also expects an increase in revenue from public utility service which it provides to the City of Sault Ste. Marie.

### COBALT—Jan. 18

**Permission to Drain Kerr Lake** has been applied for by the Crown Reserve and Kerr Lake mining companies of Cobalt. It is proposed to place a pumping plant on the lake and pump the water out into Giroux Lake, or if that be regarded as impracticable, into Glen Lake, whence it will run into the Montreal River. Kerr Lake, which is about 50 ft. deep, has an area of about 40 acres, of which the Crown Reserve owns 23, the Kerr Lake 11, and the Drummond 6. Before the Crown Reserve could begin operations it was found necessary to lower the lake 8 ft. exposing the Carson vein, from the 100-ft. and 200-ft. levels of which ore has been produced to the estimated amount of 8,253,279 oz. One-third of the Carson vein between the 100-ft. level and the bottom of the lake is intact and it is estimated that the draining of the lake would render available a large quantity of high-grade ore in addition to making accessible for prospecting a considerable area as yet untouched. On the Kerr Lake property 2,781,400 oz. in the ore reserves are under the lake. The Drummond is not so heavily interested in the project but would benefit by the opportunity afforded for prospecting in ground which is at present inaccessible. The mining commissioner before taking action will give a hearing to all parties who may be intrested.

**The Seneca Superior** company is operating the old Kerry lease on Peterson Lake. Last October, a vein of high-grade ore was encountered and this has now been drifted on for more than 215 ft. and a raise has been put up for 50 ft., with the faces still in ore. The vein will average about 3 in. in width and it is estimated that the company now has sufficient ore in reserve to pay the 25% royalty to the Peterson Lake Co., provide all the necessary working expenses, and repay the outstanding capital with substantial interest. The company is capitalized at $500,000, of which $400,000 has been issued.

### PORCUPINE—Jan. 17

**At the Next Crown Reserve Annual Meeting**, to be held shortly, an announcement is expected to the effect that this company has taken over control of the Rea mine. This property was recently leased to John Reddington and associates and presumably the deal was negotiated with the leasing company. The Rea property consists of 320 acres and a vigorous development policy will be pursued by the Crown Reserve. The old company had ore blocked out to the value of about $150,000, but developments on the lower levels were disappointing and as the treasury ran low and dissensions arose among the directors, the property has been lying idle until now. The Crown Reserve has been meeting with great success in the development of the McEnaney property which lies to the south of the Hollinger. A considerable tonnage has been blocked out and on some of the levels, the ore will average about $50 per ton. It is estimated that when the new mill is in operation, the McEnaney should be able to make about $25,000 net per month.

# THE MINING NEWS

## ALASKA

ALASKA GOLD MINES CO.—The actual development of ore, at the property of this company near Juneau, has so far been principally confined to the Perseverance workings. From the Alexander level a shaft is being raised and also sunk to the Sheep Creek tunnel level. When the east drift on the Alexander level has been extended to 2000 ft., a second shaft will be sunk to the tunnel level, from which level stoping will be commenced. The Sheep Creek tunnel is being driven at the rate of 500 ft. per mouth and it will cut the lode 700 ft. below the present lowest workings. The tunnel has already been advanced to the mineralized zone. The claim is made that previous to the destruction of the 500-ton mill by fire, ore was mined and milled for nine months at a cost of 81c. per ton.

PATTON PROPERTY—The first large shipment of ore from the Port Wells district was made recently. The shipment weighed 10 tons assaying $100 or more.

JERSEY CITY GROUP—This property on Douglas Island has been bonded to W. G. Stegman, of Juneau, who represents eastern men. The owners have been doing assessment work for the last 17 years. An 80-ft. shaft has been sunk and tunnels and crosscuts have been driven, all in pay ore. The group is owned by M. J. O'Connor, S. Zinger and William Meyer, of Juneau.

REXALL—Cooper & Horton, lessees, have their 2-stamp Joshua Hendy mill almost ready to start crushing. The mill is at the mouth of the main adit, and will be supplied during the winter with water from the mine. Underground, 485 ft. of drifting has been done and six stopes have been opened in good ore.

RELIANCE MINING CO—Cascaden & St. George have bought a third interest in the holdings of this company, all of which are on Dome Creek, and also a third interest in the Keegan-Cole lease on one of the claims.

VALDEZ CREEK PLACER MINES CO—The second payment on the Valdez Creek mines at the headwaters of the Susitna River 250 miles from Valdez, was recently made by George W. Silas, president of the company. The property taken over includes the Smith & Monohan claims, and the property owned by Dan Kane and his partners, from which some of the largest gold nuggets ever taken out of Alaska were produced. A hydraulic outfit will be shipped from Cordova as soon as W. L. Sonie, the superintendent of the property can reach Seattle and purchase the equipment. The plant which will have a capacity of washing 2000 yd. per day will be freighted from Chitna by horse teams.

YAKIMA-ALASKA MINING & DEVELOPMENT CO.—This company has been incorporated, for the development of property recently located in western Alaska. Walter N. Granger, Zillah, is interested.

## ARIZONA

### Gila County

GIBSON COPPER CO.—The monthly shipments of eight or nine carloads of high-grade chalcopyrite are being maintained.

COLE—At this property, near the Gibson, there is much ore on the dump awaiting shipment to the Old Dominion smeltery at Globe.

INSPIRATION—Development for December amounted to 3780 ft. for Inspiration and 470 ft. for Live Oak. The drifts between the Joe Bush and Scorpion shafts have established connection; 1100 ft. remain to be cut before the Scorpion and Colorado shafts will be connected by drifts. The widening of the Sulphide tunnel has been finished. The surface work of railroad building, mill-site grading, and erection of buildings continues. One of the McArthur Bros. steam shovels has been placed upon the concentrator site where 300,000 cu.yd. of earth will be removed before building can be begun. Mill and railroad work will be carried on so that all the work will be completed at the same time.

IRON CAP—The stope sheets show a steady increase in development and output since September, 1912. The force of 35 men employed at the mine will be increased.

SOUTH LIVE OAK—Drill hole No. 6 was started, Jan. 14. This hole is 350 ft. southwest of No. 5, which in turn is southwest of No. 3, and is in the same formation as that cut by those holes. No. 3 was the first hole in which the management reported discovery of ore, announcing that 65 ft. had been penetrated. In hole No. 5 the management claims to have passed through 75 ft. of 2¼% copper ore.

SUPERIOR & BOSTON—Development work is proceeding on the 600-, 800- and 1000-ft. levels. A raise is being cut between the 800- and 600-ft. levels. Work on the north crosscut on the 1200-ft. level has been suspended until the water in the face drains out. On the 1000-ft. level drifting has been started on the contact from a place 110 ft. from the station in the south crosscut. On the 800-ft. level two drifts are being driven, one to the east and the other to the southeast, the faces of both being in ore of good grade. On the 600-ft. level the drift is being advanced more to the east so as to connect with the raise being cut from the 800-ft. level.

ARIZONA COMMERCIAL—The Copper Hill shaft is now repaired practically to the bottom, 800 ft. The steel headframe which was moved from the Eureka shaft several months ago when the hoisting engine was also moved to the present working shaft, has been augmented by ore bins, a sawmill and all other equipment.

SOUTHWESTERN MIAMI—Hole No. 10 is more than 850 ft. deep, No. 11 is 270 ft. and No. 12 is about 75 ft. deep. Hole No. 9 has been finished. The new hole, No. 12, is near the contact of the schist and granite and is 500 ft. east of No. 9 hole.

### Mohave County

KINGMAN COPPER CO.—The drilling rig which is to prospect for copper ore is on the ground and the first hole will be sunk on the Superior claim which is held under option from the Southwest Turquoise Co. The wagon road to the eastern slope of Ithaca Peak has been repaired.

SILVER HILL—The recent strike on this property continues to cause considerable excitement and comment. In one place the vein is 47 ft. wide while the streak of high-grade ore is from 5 to 7 ft. wide. It is stated that this ore assays from 2 to 5 oz. of gold, 50 to 60 oz. of silver and about 30% lead, the average value being about $80 per ton. Although the new shaft is down only 10 ft., 250 sacks of high-grade ore are ready for shipment to the smelter. The vein has been stripped for quite a distance and good ore has been found all along. This property was originally located by men from Sonoma County, Calif., who were killed by the Indians. The mines were patented and eventually passed into the ownership of F. W. Theiss who merged them into the holdings of the Southwestern Reduction Co.

### Pinal County

MAGMA COPPER CO.—This company is shipping about 100 tons of high-grade copper ore weekly to the El Paso smeltery. The ore is chalcocite and bornite, rich in gold and silver. All ore produced at present is taken from the development work, little sorting being done. About 50 men are employed. The power plant was finished about two months ago, and only one man is required to operate it. Beside the power plant the equipment consists of a hoist operated by compressed air, situated in an adit beneath the surface, an office building, living quarters for the men, mess hall, an uptodate assay office, and a warehouse. These buildings are about one-quarter mile from the mine. At the mine a blacksmith shop, carpenter shop and change room have been built. The mine was once known as the Silver Queen. About two years ago the Gunn-Thompson Co. acquired control of the property, sank a shaft to the 650-ft. level and crosscut the vein, encountering high-grade chalcocite in a shoot over 120 ft. long. They also sank to the 800-ft. level and uncovered high-grade ore at that depth.

## CALIFORNIA

### Amador County

SOUTH EUREKA MINING CO.—The 3-compartment shaft caved in on Jan. 9 shortly after the morning shift had gone below. The men went out of the mine through a drift north to the Central Eureka shaft. These two adjoining mines are independently operated, by separate companies, but are so connected that each affords the other a second outlet in case of accident The closing in of the shaft occurred about 15 sets of timbers below the collar. It is an inclined shaft, and was started about 20 years ago. The present owner has been operating about four or five years. Both skips were below at the time of the accident. The extent of the damage and the direct cause have not yet been made known. The caving or closing of the timbers extended for a distance of 25 or 30 ft. The 80-stamp mill had been idle for two or three days on account of the cold.

### Butte County

GOLD BANK—Two centrifugal pumps are being installed at this mine where a 60-ton cyanide plant is also being built. M. J. Cooney, of Forbestown, manager.

BLUE HAWK—This property on Magalia ridge is being opened by Los Angeles men; 12 men are employed. C. M. Hendrix is superintendent.

### Calaveras County

AN ELECTRIC RAILWAY FROM COPPEROPOLIS is being talked of, to be built to the steam railroad station at Milton, a distance of 16 miles. Charles M. Hayden, of Boston, president, and J. H. Trerise, manager of the Calaveras Copper Co., are said to be interested in the project.

IN THE ANGELS CAMP DISTRICT, heavy rain fell on Dec. 12 and 14 and a heavy snowfall was reported in the mountains east of Angels. The total precipitation for the season is 6 in., more than 3 in. greater than in the same period in 1911. Gerald C. Collingwood, of London, has been investigating mining properties in Angels Camp district, and is reported to have stated that English investors are looking to California as the best field for mining investments.

TANNER—It is reported that a vein of high-grade ore was recently disclosed in this mine in the Murphy district.

### Kern County

WAR EAGLE CONSOLIDATED—The four claims in this group adjoining the Yellow Aster will be developed by tunnel by F. R. Cummings, of Los Angeles, owner.

KING SOLOMON—H. F. Norcross, of Los Angeles, who is interested in other mining properties in the Rand district, has purchased one-fourth interest in the mine.

GOOD HOPE—The 5-stamp mill was expected to be in operation by Jan. 15. A 30-hp. motor will drive both the mill and the crusher. The ore will be moved from mine to

mill by gravity chute. High-grade ore has been sacked and shipped to the Selby smelter. The shipment was necessitated by the filling up of the chutes underground and the accumulation of ore on the dump.

**Placer County**

PLACER COUNTY PROPERTIES CO.—This is a new incorporation organized to develop asbestos, magnesite and other minerals near Iowa Hill. The incorporators are S. M. Sprague, W. H. Beck, S. H. Turner, K. W. Keasbey. The capital stock is $500,000.

PIONEER—The ore extracted and milled is said to pay all the mining and milling costs; the concentrates are wagon hauled to Auburn and shipped by rail to Selby; 45 men are employed. The mine is on the Iowa Hill divide.

BUCKEYE—A new tunnel will be driven 350 ft. to tap the gravel 15 ft. below the channel. This will save the cost of handling the water incurred when the property was worked by following the channel. The mine is situated on Iowa Hill divide. I. H. and W. W. Rodehaver, of Auburn, are owners.

PAT GOGGINS—Development of this gravel mine on Ralston divide is progressing and good returns are reported. Sierra Nevada Development Co. is owner.

**Shasta County**

MOUNTAIN COPPER CO.—A shipment of 500 tons of Iron Mountain copper ore were recently sent by water from Martinez to the Tacoma smeltery. The transportation from the mine to Martinez is by rail.

**Tuolumne County**

ATLAS—The 10-stamp mill has been removed from the Ida Klein mine, near Stent, and is being reconstructed at the Atlas, near Tuttletown. A new mill building and a cottage for the foreman are part of the improvement. The shaft is being deepened to 500 ft. at the rate of four feet per day. J. L. Whitney, of Tuttletown, is superintendent.

COLUMBUS—A good vein of ore known as the old Smith shoot has been encountered in this mine at Cherokee. T. G. Winwood is superintendent.

**COLORADO**

**Clear Creek County**

GRAND ARMY—Operations at this property at Fall River have been resumed under the direction of L. Sternberger.

BRIDE—The shaft is 100 ft. below the tunnel level and drifts have been started.

CAPITAL—A solid body of ore measuring from 18 in. to 2 ft. wide has been uncovered on the 450-ft. level. It will mill better than $100 per ton in gold, silver and lead. The shoot has been exposed in the stope for a length of 125 ft., and an average of two carloads will be broken each week.

PELICAN, AND SEVEN-THIRTY—It is reported that following the bankruptcy sale, Mar. 13, 1913, funds will be provided for the active development of these properties by the Tarkington Mines Co.; G. W. Tarkington, manager.

**Lake County-Leadville**

STEAM AND WATER PIPES FROZE AND BURST during the recent cold weather, causing inconvenience and expense to the properties using steam, compelling the mines to close for the time being until repairs could be made. The demand for fuel throughout the city was great so that a number of mines ran short and this was another cause for closing down.

EMPIRE ZINC CO.—This company has purchased the St. Joe, Silver Waves, Eagle Bird and the Belden mines, all on Battle Mountain, Red Cliff. In early days the properties produced a heavy tonnage of lead-carbonate ore, and it is expected that zinc-carbonate ore will be found. In some of the claims there are shoots of zinc-sulphide ore which the new owners will work.

FAIRPLAY—At this mine at Adelaide Park, Manager Covey states that he has cut the ore to the south of No. 2 shaft. The ore is of better grade than that found to the north. A drift will be started at once on the new oreshoot.

MOUNT CHAMPION—Manager Smith states that the recent strike in the lower tunnel improves as the shoot is followed. The amount of work done does not show the extent of the strike, but the entire breast of the tunnel is in ore.

**San Juan Region**

THE CUSTOM ZINC SEPARATOR erected by David Foerster, and in which Huff electrostatic machines are used, has made a good record on Barstow and Atlas concentrates, as well as trial lots for other mines. The mill is operating steadily.

SMUGGLER-UNION—This company is making working tests with pebbles from Mesa County, to determine their merit in tube-mill crushing as compared with pebbles shipped from Norway. The first cost of the Mesa County pebbles is considerably less than the cost of those from Norway and if their wearing qualities are satisfactory their use will introduce an economy. Preliminary tests are reported satisfactory.

LITTLE MARY—This property in Marshall Basin is being developed and the mill is being remodeled and supplied with additional equipment. In addition to its own ore this company has arranged to treat custom ore from the Valley View property.

LEWIS—During the winter 16 men are employed on development. The main shaft will be sunk an additional 500 ft. and levels will be advanced on the vein. The mill will resume operations in the spring. Thomas Livermore is manager.

SILVER BELL—This Ophir Loop property has advanced its crosscut tunnel to a total length of 2364 ft. Several new veins have been cut, the most important of which is the Butler upon which development is now in progress. F. E. Trumble is manager.

SHERIDAN—The blacksmith shop, stables, snowsheds, timber sheds and tramway terminal, at the upper adit level in Marshall Basin, have been destroyed by fire. A. L. Moorhead, who was in charge of development work in the adit, rescued the eight men in his employ.

CAMP BIRD—This company is still exploring the new oreshoot, with results that are reported to be favorable; the mill is operating at part capacity.

WANAKAH—This company is operating its mill at full capacity. Recently installed amalgamating, regrinding, and slime concentrating machinery has given such favorable results that considerable additions will probably be made to the mill in the near future. Cyanide experiments are also being made.

REVENUE LEASING CO.—This company leasing on the Revenue Tunnel property, was forced by difficulties of milling during winter weather, to close the mill, but has announced that work will be resumed next spring.

TOMBOY—In December, 11,000 tons of ore was crushed, yielding $91,000 in bullion and concentrate; the net profit was $40,467.

**Teller County-Cripple Creek**

STRATTON ESTATE—The production from block 239 of this property on Bull Hill, which is operated by Pervis & Caley, is about three cars per week, shipped from the main vein which has been developed in the course of sinking the shaft. These lessees have developed enough ore to enable them to keep up the present production for some time.

VINDICATOR—A new and rich shoot of ore has been opened on the eighth level of the No. 2 shaft by lessees Zapp and associates. The ore is said to be from 2 to 3 ft. wide. The strike was made north of the shaft and it is said that the vein has not been opened in any other part of the mine. Millington & Co., operating a lease on No. 6 shaft are shipping regularly. Martin & Co., leasing at No. 7 shaft, have been finishing some dead work including timbering, but now all arrangements have been made to resume production and in a few days the first shipment will be made.

JERRY JOHNSON—The output in December from this mine on Ironclad Hill was 15 cars of average-grade ore, shipped by a lessee, Frank Caley and two sets of sub-lessees, one of which is working through the Damon mine. On the 550-ft. level Caley has opened a flat vein which is producing about two cars of ore per week. This ore is better than the average grade shipped from this district.

**MICHIGAN**

**Copper**

SOUTH LAKE—The shaft entered a copper-bearing formation at a depth of about 180 ft. which showed a fair amount of copper. Sinking will be continued until a depth of about 300 ft. is reached, when a crosscut will be driven.

INDIANA—This company is sinking its shaft below a depth of 1200 ft. on its way to cut the felsite formation which is estimated to lie at a depth of about 1400 ft. Sinking has been somewhat delayed owing to the comparatively large amount of water that has recently been encountered.

AHMEEK—A comparison of the report of operations for 1912 with the preceding year shows the good work that has been accomplished at this property. The cost per ton of ore stamped in 1912 was $1.39 against $1.42 in 1911; total cost per pound copper, exclusive of construction 6.65c. in 1912 as against 6.85c. in 1911; copper per ton of ore 25.3 lb. in 1912 against 25.4 lb. in 1911.

MASS—This company has gradually brought its production up to about 800 tons daily and is operating at a substantial profit.

CALUMET & HECLA—In the addition to the electric power station the foundation for the exhaust-steam turbine has been completed and shipments of the apparatus are being received. The work necessitated by the rearrangement of the switchboards is going forward satisfactorily. At the No. 2 regrinding plant the foundations have been laid and the machinery is being turned out at the company's shops. This building will contain 64 tube mills, each driven through gearing by a 40-hp. induction motor.

HANCOCK—Preparations are being made to begin ore shipments to the mill. A stamphead at the Lake Milling, Smelting & Refining Co's. mill has been contracted for, and probably within the next two months shipments will be started. Underground conditions at this property are satisfactory and the lode that was exposed some time ago at the 18th level continues well mineralized. Over 200 ft. of drifting has been done on this formation.

KEWEENAW—This company has two drilling machines in operation to test the Ashbed formation. The first hole of the series is designated as No. 38, and some delay has been experienced in sinking it, owing to caving necessitating cementing.

**Iron**

MINERAL MINING CO—Some of the machinery at the old Beta mine, has been transferred to the Konwinski mine. Two shifts are working at the James mine, for which a new change-house is planned. Several new company houses will also be built.

TULLY—Corrigan, McKinney & Co., will sink a new shaft on this property east of the one recently put down; trouble is anticipated from the deep overburden. The unwatering of the nearby Baker mine will facilitate sinking at the Tully. Both of the Tully shafts will be used for hoisting ore.

PURCELL—At this new mine of the McGreevy Steel Co. a spur from the Chicago & Northern Ry. has been laid and a coal trestle built. The shaft is down 100 ft. and 15 men are employed.

McGREEVY STEEL CO.—Machinery is being ordered for the Boyington, and Sheridan properties which, according to present plans will be opened in the spring.

BENGAL—The second level has been reached in shaft sinking, and drifting to the south and east has been started. Concrete foundations have been completed for the steel shaft-house and air compressor.

BAKER—Corrigan, McKinney & Co., has been moving company houses from this property to the Tully mine.

FLORENCE IRON CO.—This company has taken an option on the Sheldon lands in Sec. 19, 42-32, Crystal Falls district, which is east of the Mastodon find of the Nevada Land Co.

ERNST—At this new mine at Commonwealth, Wis., a spur of the Chicago & Northwestern Ry. is being laid preparatory to shipping ore next season.

## MINNESOTA

DULUTH, MISSABE & NORTHERN RY.—Work is to be started in February on an ore dock at this company's terminal at Duluth. The dock will be 2300 ft. long, and will have 384 pockets each of 100 tons capacity. Ore will be discharged from either side and it will be possible to load 10 of the largest lake freighters at the same time. The cost is estimated at $2,750,000.

### Mesabi Range

.. THE SHORTAGE OF MEN in this region is being keenly felt, some mines being upon the point of closing down for the season.

## MISSOURI

### Joplin District

AT SPRING CITY development work is being done on a 30-acre tract, in the southern part of the camp, owned by A. B. Thomas. Free pebble jack has been encountered at depths of 30 to 100 ft. and the ground is being opened up in readiness for a mill. Deep mining has been the rule here and only recently have shallow deposits been opened up.

KANE & WOOD—These operators have taken a lease on a six-lot tract of the Reliance Mining Co. land at Neck City and have encountered a good run of lead ore at 80 ft. The ore is cleaned at present on hand jigs as it is free and easily treated; jack is known to occur at greater depth.

POCAHONTAS—S. M. Short has sold a part of his interest in this mine for $40,000. He is to remain in charge of the property. This mine produces 500,000 lb. of concentrate per week.

MARY ELIZABETH MINING CO.—A rich sheet-ground property in the Webb City field is being developed by this company. The mine was opened up and a mill built 12 years ago, but ore prices were low and the water was hard to keep down. The ground is now drained largely by surrounding mines, a 2-in. pump being required to hold the water. A 9-ft. face of ore has been proved and the ground developed by 12 or more drill holes. The company is incorporated for $50,000 and contemplates building a new mill.

AMERICAN ZINC, LEAD & SMELTING CO.—This company has placed four prospect drills in operation in the Aurora camp. They are testing leases northeast of the city.

POWHATTAN—This S. M. Short mine on a lease of the Madison Lead & Zinc Co's. land at Thoms Station is to be equipped with a mill from the Continental land west of Joplin. The mill is of 150 tons capacity. The ground has been developed by five drill holes in ore, a shaft has been sunk and drifts started. Mr. Short is also moving the Cherokee mill from the Snapp land to the Waneta Pearl mine.

DUTCHMAN'S DREAM—This mine has been taken over by the Watson brothers, of Kansas City, and a company incorporated for $100,000. The ground will be opened up and a mill built. The mine is in the west part of the Thoms Station field where the operators are interested in other producing mines.

## MONTANA

### Butte District

EAST BUTTE—Preparations are being made to increase the capacity of the concentrator at the smeltery from 300 to 600 tons daily. William Castleton, superintendent of the concentrator, has been studying the changes recently made in remodeling the first section of the concentrator at the Washoe smeltery at Anaconda, with a view to the adoption of some of the features in the East Butte mill. It is probable that Hancock jigs will be installed.

NORTH BUTTE—Excellent ore has been developed on the 2400-ft. level of the Speculator mine on the Snowball vein. The vein is wide and high-grade bornite has been blocked out. The same vein has been penetrated on the hanging-wall side by a crosscut on the 2800-ft. level. The Gem vein on the 2600-ft. level is showing ore.

TUOLUMNE—Recent development on the 2000-ft. level of this property leads to the belief that a second enrichment zone has been encountered, after passing through the lean territory between the 1600- and 1800-ft. levels. A crosscut on the 2000-ft. level entered what is believed to be a split of the main vein. Drifting has been started on this vein and the crosscut will be continued to ascertain if the main vein lies beyond.

### Deer Lodge County

SOUTHERN CROSS—Sinking has been resumed at this property of the Anaconda company in the Georgetown district, the intention being to go down another 200 ft. giving a total depth of more than 500 ft. Although some delay has been experienced in getting the new electric hoist and other machinery, on the ground, it is believed that everything will be in readiness for operations some time in February, when ore shipments to the Washoe smeltery at Anaconda will begin.

### Fergus County

BARNES-KING—The mill at this property at Kendall began operations upon ore from the North Moccasin mine about the middle of December and has since been treating a little less than 100 tons of ore per day. In Dec. 1757 tons or ore, assaying about $8.50 per ton, was treated. While the mill has a capacity for treating 200 tons daily, it is probable that no more than 100 tons daily will be milled until the water supply increases in the Spring. Ore has been opened for a length of 100 ft. on the 500-ft. level, and as yet shows no signs of pinching.

### Madison County

BURDEN—Recently lessees operating one of the Burden claims in West Georgia gulch, near Twin Bridges, opened a 4-in. lead, assaying $650 in gold, at a depth of 50 ft. from the surface.

BEDFORD—The Waters Tunnel Co., which is operating this mine in Ramshorn gulch, south of Sheridan, has made arrangements with the Madison River Power Co. for the construction of an electric power line to the property. Work has begun upon a loop to the mine from the main line which leads down the valley from Ruby.

### Sanders County

A LARGE TRACT OF PLACER GROUND on Vermilion Creek has been leased by Butte men who are preparing to begin extensive operations. They will install drills to determine bedrock depth, and whether it will be best to work the gravel by dredging or by hydraulicking.

## NEVADA

### Comstock Lode

CROWN POINT—Two centrifugal pumps of 1500 gal. per min. capacity have been ordered to be placed in the winze to reduce the water level, which is now at the 1500-ft. level. Two Scranton pumps, recently in use at the Ward shaft have been loaned to the company, and they will be used with the equipment to be purchased. The work of cleaning out the old drainage drift to the Sutro tunnel has been started, and the drift will serve as the outlet of the water pumped from the lower levels. One of the new pumps will be placed in the Alta shaft, which is connected with the Sutro tunnel by a drainage drift.

MEXICAN—The cable for the new aërial tramway to be built from the mill to the Keyes, and Monte Cristo properties, has arrived and will be installed as soon as the weather will permit. The terminals for the tram are now practically completed.

CONSOLIDATED VIRGINIA—Work has been started enlarging the old wheel pit at the 1000-ft. level of the C. & C. shaft, which will be used as the base for operations in driving into virgin ground to the East vein, which the old records indicate has never been explored on this level above the bonanza.

CHOLLAR—The Chollar Leasing Co. operating on the upper levels of the Chollar, and Potosi mines, is planning to increase the equipment of the Butters' milling plant, which will greatly increase its capacity.

OPHIR—The Ophir company is preparing to drive east from the north lateral of the Sutro tunnel to explore the ground over an old stope that yielded heavily several years ago, but was not followed above the 1600-ft. level.

### Nye County

Shipments in tons from Tonopah mines for the year to date and for the week ended Jan. 11, are as follows:

| Mines | Week | Year to Date | Mines | Week | Year to Date |
|---|---|---|---|---|---|
| Tonopah Mining | 3400 | 6550 | North Star | ..... | 45 |
| Tonopah Belmont | 3321 | 6535 | Mizpah Extension | ..... | ..... |
| Montana-Tonopah | 884 | 1698 | Jim Butler | 300 | 600 |
| Tonopah Extension | 950 | 1850 | Tonopah Merger | 108 | 323 |
| West End | 810 | 1910 | | | |
| Midway | 45 | 45 | Totals | 10,319 | 20,607 |
| MacNamara | 501 | 051 | Estimated value | $217,272 | $432,822 |

TONOPAH-BELMONT—The report for December states that 11,740 tons of ore was milled for a net profit of $172,450. The falling off in output as compared with November was due to the Christmas holidays and shortage of electric power.

WEST END—In December, 1912, 4350 tons of ore was milled for a net profit of $36,859.

JIM BUTLER—It is stated that 1268 tons of ore assaying $26 per ton was treated at the old Belmont mill for a net profit of $11,596.

## NORTH CAROLINA

### Guilford County

NORTH CAROLINA-PARTRIDGE SMELTING CO.—This company is erecting a furnace on a dump of copper ore near Greensboro. The company expects to begin production about Feb. 1, at the rate of 5 tons of matte per day.

## OREGON

### Baker County

ZENITH—Development work at this mine will be continued throughout the winter, under the direction of D. L. Willard, manager. The property is near Sumpter.

SNOW CREEK—New machinery for unwatering the shaft is being installed at this property near Greenhorn. Frederick Smith has charge of the work.

## SOUTH DAKOTA

### Lawrence County

AT THE BLACK HILLS SMELTERY, contracts for ore and preparations for blowing in the plant early this spring are being made. The plant is at Galena. As outlined at present the pyrite will be secured from the Gilt Edge mine, at Galena, 15 tons of ore daily and 10 tons of concentrate. Ore containing 8% copper, will be secured from the Jungle mine, at Custer Peak, at the rate of 10 tons daily. The supply of dry ores appears sufficient for the full tonnage, 150 daily. E. W. Walter, formerly of Silverton, Colo., is in charge.

GOLDEN CREST—On Jan. 7, the date of expiration of the year of redemption under which sheriff's sale was made a year ago, the Detroit interests in this company paid to F. W. Bird and associates, holders of the judgment, for $120,000, $19,513, and to the treasurer of Lawrence County $4513. The first amount covered costs and interest for one year, and the second taxes in full. This payment secured for the Detroit

men an additional year for redemption. The property is equipped with a 40-stamp mill.

GOLDEN REWARD—The new roasting plant at the Astoria mine has been started; after several days of gradual warming up the oil fires were lighted Jan. 12. The plant has a capacity of 75 tons daily, but is built to accommodate a second unit of equal capacity, which will be installed as soon as the first has been proved a success.

BISMARCK—The new 300-ton cyanide plant of this company, at Flatiron, was started early this month, and is now in steady operation at full capacity. The property adjoins the Wasp No. 2, where $2 ore is being profitably mined through glory holes, there being 55 ft. of ore exposed. A gasoline locomotive will be purchased for hauling.

TITANIC—This company has secured a lease and bond on the Iron, Seabury and Segregated properties, at Carbonate, adjoining its main tract of 650 acres, and work will be taken up on the new property at an early date. This new acquisition has not been operated for 20 years, and was formerly a heavy producer of high-grade silver-lead ores. The ore occurred in the limestone, and no workings ever penetrated the quartzite. The new operators propose to sink to and thoroughly to prospect the quartzite. W. S. Elder, of Deadwood, is local manager.

TROJAN—This company has recently received from the Kilbourne & Jacobs Manufacturing Co., 40, gable-bottom ore cars of 1½ tons capacity each, equipped with a special roller bearing. These cars will be used in hauling ore from the mine to the mill, over the tram on which the gasoline locomotives are in operation.

## TEXAS

### Cherokee County

O'NEILL SYNDICATE—Press dispatches state that H. A. O'Neill and associates who recently leased the iron furnace and pipe works of the state penitentiary at Rusk have acquired additional ore lands in this region bringing the total estimated holdings up to 60,000,000 tons. They have also secured options on other tracts of ore-bearing land. The syndicate is making preparations to build a $200,000 plant for washing the ore, and charcoal kilns. Steam shovels will be used. The rehabilitation of the furnace at Rusk will be finished in about 90 days.

## UTAH

### Beaver County

MAJESTIC—Since May 1, 1912, this company has shipped 285 cars of copper-iron ore, or 14,250 tons.

### Juab County

DRAGON CONSOLIDATED—Iron ore is being shipped at the rate of 100 tons daily, and extensive development is being done in the southern end of the property, in search of other ores.

CHIEF CONSOLIDATED—This company closed the year of 1912 with a cash balance of $305,000.

IRON BLOSSOM—The new electric hoisting equipment is being tried out, and will, it is expected, be in operation within a few days.

EAGLE & BLUE BELL—This company has declared its first dividend, amounting to 5c. per share payable Feb. 1.

YANKEE—The company will hold its annual meeting Jan. 27, when figures on zinc production will be placed before stockholders.

OPOHONGO—A dividend of 1c. per share has been declared, payable Jan. 30. This amounts to $8989.

### Summit County

ONTARIO SILVER—The annual stockholders' meeting will be held in San Francisco, Jan. 20.

## WASHINGTON

### Ferry County

JIM BLAINE—Some fine ore has recently been encountered at this property in the Republic district. George S. Bailey, has charge of the work.

### Okanogan County

GOLDEN CHARIOT—Shipments to the smelter have been started from this property, and some rich ore has recently been taken out. This mine is in the Oroville district.

## CANADA

### British Columbia

CROWN MINES CO.—Carbonate ore measuring from four to seven feet wide has been struck in the property of this company at Ainsworth. W. A. Davidson is the manager. The find was made at a depth of 75 ft. and the shoot was developed for a distance of 40 ft. by drift and is now being followed by winze.

SILVER HOARD MINING CO.—Production from the property of this company in the Ainsworth district is to be increased in January when ore will be hauled from the mine to the tramway at the No. 1 mine of the Consolidated Mining & Smelting Co. W. S. Hawley is president. Three tons has been the rate of production by teams. This will be increased until a maximum of 300 tons per month is moving. A 100-ton bin has been built at the upper tunnel of the tramway and a rail tramway will be built between the mine and the terminal in the spring. The mill forces will be doubled and a 5-drill compressor installed.

RAMBLER-CARIBOO—Five carloads of lead-silver ore have been shipped from this mine in the Slocan district since the tramway was put in permanent commission several weeks ago.

GRANBY CONSOLIDATED—The directors have decided to capitalize the construction of the Hidden Creek smeltery and development work and to this end $5,000,000 convertible bonds will be issued. To provide for bond conversion an increase from $15,000,000 to $20,000,000 in capital stock will be asked of stockholders. Dividends have also been resumed with the declaration of $1.50 per share, payable Mar. 1 to stockholders of record Feb. 4. Of the proposed $5,000,000 bonds, which are to be convertible into stock at not less than par, $1,500,000 will be offered to stockholders at par, pro rata, while the remaining $3,500,000 will be reserved for further expenditures to issue as directors deem advisable.

### Manitoba

PENNIAC REEFS—George Thurber, manager of this mine at Star Lake near the Ontario boundary, recently extracted 42 oz. of gold by the Thurber process in a test run of 65 tons of ore.

### Nova Scotia

DOMINION COAL CO.—The Emery colliery at Sydney, closed since 1902, is to be reopened. The mine was first opened in 1899 and two slopes each 1600 ft. long were driven, but it has been allowed to fill with water.

### Ontario Cobalt

Shipments of ore and concentrates, in tons, from Cobalt for the week ended Jan. 17 were as follows:

| | | | |
|---|---|---|---|
| Bailey | 20.00 | Kerr Lake | ..... |
| Beaver | ..... | La Rose | 87.43 |
| Buffalo | ..... | Lost and Found | ..... |
| Casey Cobalt | 30.00 | McKinley-Darragh | 41.80 |
| Chambers-Ferland | ..... | Nipissing | ..... |
| City of Cobalt | ..... | O'Brien | ..... |
| Cobalt Lake | 32.26 | Penn.-Canadian | ..... |
| Cobalt Townsite | 73.93 | Provincial | ..... |
| Colonial | ..... | Right of Way | ..... |
| Coniagas | ..... | Seneca Superior | 42.15 |
| Crown Reserve | ..... | Silver Queen | ..... |
| Dominion Reduction Co. | 59.89 | Timiskaming | 31.04 |
| Drummond | 20.00 | Trethewey | 29.30 |
| General Mines | ..... | Wettlaufer | ..... |
| Hargraves | ..... | | |
| Hudson Bay | ..... | Total | 467.80 |

COBALT-LAKE—Excavations have been commenced for an addition to the stamp mill, which will double its capacity at a cost of $40,000.

PENN-CANADIAN—This company, which has been operating the old Cobalt Central, produced 100,000 oz. last year.

CROWN RESERVE—The regular monthly dividend of 2% with a 3% bonus, payable Feb. 15, has been declared.

### Ontario-Porcupine

HOLLINGER—The regular dividend, payable Jan. 28, has been declared.

JUPITER—It is stated that the company has decided to build a stamp mill. Definite plans have not as yet been made, but it is believed that construction will commence about the first of April. The crushed ore will be treated on amalgamating plates and then cyanided.

## MEXICO

### Chihuahua

RIO PLATA MINING CO.—At a stockholders meeting held Jan. 16, it was stated that $84,000 profit had been made in 1912; that concentrate now at the mine in Mexico would realize enough to cancel all debts of the company in that country; and that the surplus in the treasury was about $110,000. No ore of commercial grade is known to exist in the Rio Plata mine. After paying a dividend of 1% in February, 1913, the surplus will be invested in another property provided one of promise can be found. The company has already invested in the Trinity Consolidated, a placer property in Trinity County, Calif., but which is not yet producing.

NORTHERN MEXICO POWER CO.—This company is now building a dam, erecting the steel work of the power plant and installing some of the machinery at its hydro-electric power project at La Boquilla, 20 miles from Santa Rosalia. Power will be supplied to Parral, Naica, Chihuahua and other mining camps in the State of Chihuahua. The dam is being built of rock-faced cyclopean concrete between high bluffs; it will be 276 ft. high, 1200 ft. long, and impound water in a reservoir 20 miles long. It is expected that construction work will be completed this year. W. B. Fuller is chief engineer and general superintendent.

AMERICAN METAL CO.—This company which recently purchased the Paloma and Cabrillas mines in this state, has taken working leases on the J. J. Murphy property at Cedral, and the Florida mine in the Bajan camp. The price paid for the Paloma was 2,000,000 pesos, and for the Cabrillas 2,400,000 pesos. The company is closely associated with the Penoles mining company, operating the principal mines and the smeltery at Mapimi, Durango.

MAZAPIL COPPER CO—This English company, operating mines and a copper smeltery in the Concepcion del Oro district of Zacatecas, and a lead smeltery at Saltillo, has contracted with a Belgian syndicate for all of its zinc ores for a period of two years. The ores will be shipped through Tampico.

### Sonora

LUCKY TIGER—An extra dividend of 1c., making a total of 6c. per share has been declared for January. An extra dividend of 2c. was declared in December. The company has outstanding 715,537 shares. From 1912 profits the company paid $336,208 in dividends and $297,868 in bond and note obligations.

## SOUTH AMERICA

### Colombia

CERTIGUE MINING & DREDGING CO.—The 5-cu.ft. bucket, Empire dredge of this company sunk on the night of Dec. 1, 1912, two of the three men on the boat losing their lives. A heavy rain caused the river to rise suddenly about 30 ft., bringing down heavy logs and driftwood, which broke a hole in the hull. The dredge was built at Quibdo in 1907, and was towed 50 miles to the Certigue field, at the head waters of the Atrato River. It is understood that plans are being made for dismantling the wrecked dredge, and using the machinery in a new steel hull.

# THE MARKET REPORT

## METAL MARKETS

**NEW YORK—Jan. 22**

The copper market has been generally upset and demoralized, with a downward tendency. Other metals have been more quiet, with few changes.

Exports of gold through the port of New York week ended Jan. 18 were $5,157,807, chiefly to Paris; of silver, $1,156,807, principally to London. Imports of gold were $266,292; of silver, $208,944, mostly from Mexico and South America.

Imports of gold in France 11 months ended Nov. 30 were 227,149,000 fr.; exports, 31,742,000 fr.; excess of imports, 195,407,000 fr., being 92,494,000 fr. more than in 1911. Imports of silver were 247,000,000 fr.; exports, 243,136,000 fr.; excess of imports, 3,864,000 fr., or 49,576,000 fr. less than in the previous year.

### Gold, Silver and Platinum

**Gold**—The price of gold on the open market in London remained at the bank value, 77s. 9d. per oz. for bars and 76s. 4d. per oz. for American coin. In New York $2,000,000 additional was taken for export to Paris and $2,300,000 for Brazil.

**Iridium**—This metal is still rather scarce and $70@75 per oz. is asked. Our Russian correspondent reports that at Ekaterinburg, the primary market in the Urals, there is a strong demand for osmiridium, but none is being offered for sale.

**Platinum**—The market is steady and prices are unchanged. Dealers here ask $45@46 per oz. for refined platinum; $49@51 for hard metal, according to quantity. Hard metal has advanced lately, owing to the high price of iridium. The metal used for sparking points in automobile engines is a high-grade, running up to 25% iridium, and brings the higher price.

**Our Russian Correspondent** writes under date of Jan. 3, that the markets are strong. The starateli in the Urals have generally stopped work on account of severe weather and the holidays. The demand is good, especially for small lots. Stocks of platinum are decreasing quickly. Quotations for small lots at Ekaterinburg are 9.80 rubles per zolotnik for crude metal, 83% platinum; at St. Petersburg, 37,700 rubles per pood for the same grade—equal to $36.85 and $36.95 respectively; but these figures are nominal and subject to negotiation.

**Silver**—The market has ruled quiet and steady without any special feature. Tendency has been toward lower quotations on lack of demand from India. China buying has supported the price. The market closes steady at 28⅞d. in London.

**Exports of Silver from London to the East** Jan. 1 to Jan. 9, reported by Messrs. Pixley & Abell:

| | 1912 | 1913 | Changes |
|---|---|---|---|
| India | £193,300 | £5,500 | D. £187,800 |
| China | 80,000 | 10,000 | D. 70,000 |
| Total | £273,300 | £15,500 | D. £257,800 |

The net import of gold into India for the month of December was £2,506,667 (approximate), making a net import for 1912 of £27,592,865. Of this total about £9,000,000 went into the gold reserves of the Indian currency. The remainder, about $18,600,000, was absorbed by the Indian people.

### Copper, Tin, Lead and Zinc

**Copper**—The market, which closed very unsettled on Jan. 15, seemed to be righting itself on Jan. 16 and 17, when some moderate sales were made at 16⅜@16½c., delivered, usual terms, but on Jan. 18, further weakness developed, and on Jan. 20, there was a big slump in the London standard market, which demoralized things here. On that date rather large sales by second hands were made at 15⅝@15¾c. Some of the principal sellers showed a reluctance to follow the decline, but one sought constantly to place copper, and this was also the policy of several of the small producers. Buyers were, of course, frightened by the character of the market, but upon the little recovery on Jan. 21, they took hold at around 16c., delivered, and a fair business ensued, which seems to have about cleaned up the cheaper offerings. On Jan. 22, when the London market, for the first time in a long while, reacted sharply upward, consumers generally showed more interest and at the close it looks as though a larger buying movement were impending. During the week just passed the volume of business transacted must have been fairly large in the aggregate. At the close Lake copper is quoted at 16⅜@16½c.; and electrolytic in cakes, ingots and wirebars at 16@16.10c. Casting copper is quoted nominally at 15.75@15.85c. as an average for the week.

On Jan. 16, the London standard market for spot was £71, for three months £71 12s. 6d.; on Jan. 17 it was £70 18s. 9d. and £71 5s., respectively. On Monday, Jan. 20, in consequence of some forced sales and a bear attack, the market broke heavily and closed at £68 15s. for spot and £69 2s. 6d. for three months, a decline of over £2. It held at around these figures on Jan. 21. On Jan. 22, in consequence of the better political outlook and the improved tone of the stock markets, bears started to cover and the market reacted, and closed at £70 8s. 9d. for spot, and £70 13s. 9d. for three months.

Copper sheets are 23@24c. per lb., base for large lots;

DAILY PRICES OF METALS

NEW YORK

| Jan. | Sterling Exchange | Silver | Copper | | Tin | Lead | | Zinc | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Lake, Cts. per lb. | Electrolytic, Cts. per lb. | Cts. per lb. | New York, Cts. per lb. | St. Louis, Cts. per lb. | New York, Cts. per lb. | St. Louis, Cts. per lb. |
| 16 | 4.8700 | 63⅛ | 16¼ @16¼ | 16.20 @16.30 | 50¾ | 4.30 @4.32½ | 4.15 @4.17½ | 6.90 @7.00 | 6.85 @6.95 |
| 17 | 4.8715 | 63 | 16¼ @16¼ | 16.20 @16.30 | 50¾ | 4.30 @4.32½ | 4.15 @4.17½ | 6.90 @7.00 | 6.85 @6.95 |
| 18 | 4.8730 | 63 | 16⅛ @16 | 16.00 @16.10 | 50¾ | 4.30 @4.32½ | 4.15 @4.17½ | 6.85 @6.95 | 6.80 @6.90 |
| 20 | 4.8730 | 63⅛ | 15⅞ @16 | 15.60 @15.80 | 50¼ | 4.30 @4.32½ | 4.15 @4.17½ | 6.85 @6.95 | 6.80 @6.90 |
| 21 | 4.8750 | 63 | 16 @16⅛ | 15.75 @15.95 | 50¼ | 4.30 @4.32½ | 4.15 @4.17½ | 6.80 @6.90 | 6.75 @6.85 |
| 22 | 4.8750 | 62⅞ | 16⅛ @16¼ | 16.00 @16.10 | 50¼ | 4.30 @4.32½ | 4.15 @4.17½ | 6.80 @6.90 | 6.75 @6.85 |

The quotations herein given are our appraisal of the market for copper, lead spelter and tin based on wholesale contracts with consumers without distinction as to deliveries; and represent, to the best of our judgement, the bulk of the transactions, reduced to basis of New York, cash, except where St. Louis is specified as the basing point. The quotations for electrolytic copper are for cakes, ingots and wirebars. The price of electrolytic cathodes is usually 0.05 to 0.10c. and that for casting copper usually about 0.125 to 0.2c. belo w that of electrolytic. The quotations for lead represent wholesale transactionsin the open market for good ordinary brands, both desilverized and non-desilverized; specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium. Silver quotations are in cents per troy ounce of fine silver.

LONDON

| Jan. | Silver | Copper | | | Tin | | Lead, Spanish | Zinc, Ordinaries |
|---|---|---|---|---|---|---|---|---|
| | | Spot | 3 Mos | Best Sel'td | Spot | 3 Mos | | |
| 16 | 29 1/16 | 71 | 71⅛ | 78 | 228½ | 226½ | 16½ | 26 |
| 17 | 29 | 70 15/16 | 71⅛ | 77 | 228½ | 227 | 16½ | 26 |
| 18 | 29 | .... | .... | .... | .... | .... | .... | .... |
| 20 | 29 1/16 | 68¾ | 69⅛ | 75 | 227½ | 225¾ | 16⅛ | 26⅛ |
| 21 | 29 | 68¾ | 69⅛ | 75 | 226½ | 224½ | 17 | 26⅛ |
| 22 | 28¾ | 70 1/16 | 70 11/16 | 76⅛ | 228¼ | 226¼ | 17⅛ | 26⅛ |

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb, except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.26c.; = £25 = 5.44c.; £70 = 15.22c. Variations, £1 = 21¾c.

full extras are charged and higher prices for small quantities. Copper wire is 19c. per lb., carload lots at mill.

Exports of copper from New York for the week were 4463 long tons. Our special correspondent gives the exports from Baltimore at 1246 tons.

**Visible Stocks of Copper** in Europe on Jan. 15 are reported as follows: Great Britain, 26,270; France, 4620; Rotterdam, 1400; Hamburg, 5200; afloat from Chile, 2900; afloat from Australia, 2780; total 43,170 long tons, or 96,700,800 lb. This is a decrease of 70 tons from the Dec. 31 report.

The Rome Wire Co. of Rome, N. Y., has issued a folder showing the average price of copper from 1883 to 1912, inclusive, which will be forwarded to anyone desiring a copy.

**Tin**—Through a reluctance on the part of eastern interests to offer the metal freely, it maintained its firm tone on the London Metal Exchange during the last week. Demoralization of the speculative copper market at the beginning of this week, however, did not fail of its effect on tin, and the market became weak. In this market, the softer tendency found its expression in an easing of the spot situation. The premium over the import price, which a few days before had reached 1c. per lb., almost entirely disappearing. At the lower level of prices, there was a fair inquiry on the part of consumers. The market recovered very quickly, and closes firm at £228 5s. for spot and £226 5s. for three months, in London, and about 50⅝c. for February delivery here.

**Lead**—The market is without special feature, with a fair business doing at last prices, 4.15@4.17½c., St. Louis, and 4.30@4.32½c., New York.

The European market for lead is much firmer and cables report a good business doing. Spanish lead has advanced to £17 2s. 6d., and English lead is quoted at £17 10s. per ton.

The average price of lead for the week was 4.3125c., New York.

An order has been issued by the Treasury Department directing that lead from foreign bullion refined in this country under bond may be withdrawn without payment of duty, if intended to be manufactured into material for the construction or repair of ships.

**Spelter**—The demand has fallen off considerably, and some pressure on the part of producers to market metal has resulted in lower prices. Consumption, generally speaking, continues good. At the close, St. Louis is quoted at 6.75@6.85c.; New York, 6.80@6.90c.

The European market is firmer, good ordinaries being quoted £26 2s. 6d., and special 12s. 6d. higher.

Base price of zinc sheets is $9 per 100 lb., f.o.b. La Salle-Peru, Ill., less 8% discount.

A cargo of 1500 tons of zinc ore by SS. "St. Patrick," from Yokohama, was entered at Baltimore this week.

Zinc dust is quoted at 7⅝c. per lb., New York.

## Other Metals

**Aluminum**—The market has been more active, and demand is improving. Prices are firmer, 26½@27c. being quoted for No. 1 ingots, New York, according to deliveries. The foreign market is very firm.

**Antimony**—Business has been rather better and the market is gradually getting into shape; it was overbought on the rise in December, and the later reaction was the consequence. Cookson's is quoted 9.75@10c. per lb., and Hallett's 9.25@9.50c., while 8.82½@9.12½c. is the range for Chinese, Hungarian and other outside brands.

**Quicksilver**—Business has been rather quiet and prices are unchanged. New York quotation is $40 per flask of 75 lb., with 59c. per lb. asked for retail lots. San Francisco, $40 for domestic orders and $37.50 for export. London price is £7 15s. per flask, with £7 10s. quoted by jobbers.

**Bismuth**—The syndicate which controls the European production quotes 7s. 6d.—equal to $1.80—per lb. in London. In New York a quotation of $1.72 per lb. is made for metal produced from American ores.

**Cadmium**—The latest quotation from Germany is 725@750 marks per 100 kg. f.o.b. works in Silesia. This is equal to 78.27@80.97c. per lb. at works.

**Nickel**—Shot, blocks and plaquettes bring 40@45c. per lb., according to quality. Electrolytic nickel is 3c. per lb. higher.

**Magnesium**—The price of pure metal is $1.50 per lb. for 100-lb. lots, f.o.b. New York.

## Zinc and Lead Ore Markets

**JOPLIN, MO.—Jan. 18**

Prices unchanged, but demand weaker; high price zinc blende $59, the base per ton of 60% zinc $53@56. Calamine sold at $28@32 per ton of 40% zinc. The average of all grades of zinc is $53.34 per ton. Lead sold on a base of $53 per ton of 80% metal contents and the average of all grades is $51.66 per ton.

SHIPMENTS, WEEK ENDED JAN. 18

| | Blende | Calamine | Lead Ore | Value |
|---|---|---|---|---|
| Total for week | 10,616,430 | 437,940 | 1,819,310 | $341,908 |
| Three weeks | 33,474,000 | 1,328,410 | 5,512,000 | $1,069,154 |
| Blende value, the week | | | | $287,813; 3 weeks, $904,040 |
| Calamine value, the week | | | 7,102; 3 weeks, | 20,865 |
| Galena value, the week | | | 46,993; 3 weeks, | 144,249 |

**PLATTEVILLE, WIS.—Jan. 18**

The premium price paid this week for zinc ore was $56. The base price for 60% zinc ore was $54@55 per ton. No sales of lead ore were reported.

SHIPMENTS WEEK ENDED JAN. 18

| | Zinc ore, lb. | Lead ore, lb. | Sulphur ore, lb. |
|---|---|---|---|
| Total for week | 3,362,630 | ..... | 963,500 |
| Year to date | 9,900,870 | 114,100 | 3,032,200 |

Shipped during week to separating plants, 1,794,920 lb. zinc ore.

COPPER SMELTERS' REPORTS

This table is compiled from reports received from the respective companies, except in the few cases noted (by asterisk) as estimated, together with the reports of the U. S. Dept. of Commerce as to imported material, and in the main represents the crude copper content of blister copper, in pounds. In those cases where the copper contents of ore and matte are reported, the copper yield thereof is reckoned at 95%. In computing the total American supply duplications are excluded.

| Company | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|
| Alaska shipments | 1,726,715 | 1,435,235 | 1,671,367 | 3,766,029 |
| Anaconda | 24,500,000 | 25,250,000 | 24,250,000 | 23,400,000 |
| Arizona, Ltd. | 3,340,000 | 3,200,000 | 3,000,000 | 3,100,000 |
| Copper Queen | 9,103,861 | 8,184,575 | 8,807,940 | 8,805,568 |
| Calumet & Ariz | 4,462,000 | 4,404,000 | 4,918,000 | 5,840,000 |
| Chino | 3,217,369 | 3,638,500 | 3,911,169 | 3,368,850 |
| Detroit | 1,881,668 | 1,934,828 | 1,968,620 | 2,389,875 |
| East Butte | 1,416,830 | 1,398,177 | 1,245,504 | 1,314,021 |
| Mammoth | 1,834,937 | 1,883,283 | 1,805,869 | ..... |
| Giroux | 1,005,208 | ..... | ..... | ..... |
| Mason Valley | 1,200,000 | 1,563,700 | ..... | ..... |
| Nevada Con | 5,607,578 | 850,741 | ..... | ..... |
| Ohio | 635,000 | ..... | ..... | ..... |
| Old Dominion | 2,204,000 | 2,523,000 | 2,758,000 | 2,262,000 |
| Ray | 2,978,404 | ..... | 3,201,500 | ..... |
| Shannon | 1,142,000 | 1,210,000 | 1,436,000 | 1,360,000 |
| South Utah | 225,568 | ..... | ..... | ..... |
| United Verde* | 2,750,000 | 2,750,000 | ..... | ..... |
| Utah Copper Co | 6,616,887 | 2,022,352 | ..... | ..... |
| Lake Superior* | 19,250,000 | 21,500,000 | 20,400,000 | ..... |
| Non-rep. mines* | 8,094,792 | 8,250,000 | 8,250,000 | ..... |
| Total production | 103,025,987 | ..... | ..... | ..... |
| Imports, bars, etc | 25,149,329 | 28,205,270 | 22,797,099 | ..... |
| Total blister | 128,175,316 | ..... | ..... | ..... |
| Imp. in ore and matte | 7,142,232 | 11,224,879 | 8,149,728 | ..... |
| Total American | 135,317,548 | ..... | ..... | ..... |
| Miami† | 2,949,150 | 2,577,750 | 2,972,000 | 2,913,840 |
| Brit. Col. Cos.: | | | | |
| British Col. Copper | ..... | 1,022,904 | 881,582 | ..... |
| Granby | 2,083,118 | 2,018,424 | 1,852,896 | ..... |
| Mexican Cos.: | | | | |
| Boleo† | ..... | 2,612,400 | 2,315,040 | 2,480,240 |
| Cananea | 3,500,000 | 4,428,000 | 5,064,000 | 4,592,000 |
| Moctezuma | 771,844 | 3,045,667 | 2,112,377 | 2,793,781 |
| Other Foreign: | | | | |
| Cape Cop., S. Africa | 678,720 | 757,120 | 907,200 | 770,560 |
| Kyshtim, Russia | 1,750,000 | ..... | ..... | ..... |
| Spassky, Russia | 981,120 | 974,000 | 974,400 | ..... |
| Tilt Cove, Newf'd | ..... | 86,785 | ..... | ..... |
| Exports from | | | | |
| Chile | 6,048,000 | 8,512,000 | 4,816,000 | 7,392,000 |
| Australia | 7,616,000 | 9,520,000 | 10,752,000 | 9,856,000 |
| Arrivals in Europe$ | 8,518,720 | 13,771,520 | 12,976,320 | 16,363,200 |

† Boleo copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister.
$ Does not include the arrivals from the United States, Australia or Chile.

STATISTICS OF COPPER

| Month | United States | | | Visible Stocks. | | |
|---|---|---|---|---|---|---|
| | U.S.Refin'y Production | Deliveries, Domestic | Deliveries, for Export | United States | Europe | Total |
| Year, 1911 | 1,431,938,338 | 709,611,605 | 754,902,233 | ..... | ..... | ..... |
| I, 1912. | 119,337,753 | 62,343,901 | 80,167,904 | 89,454,695 | 158,323,200 | 247,777,895 |
| II..... | 116,035,809 | 56,228,368 | 63,148,096 | 66,280,643 | 154,851,200 | 221,131,843 |
| III.... | 125,694,601 | 67,487,466 | 58,779,566 | 62,939,988 | 141,142,400 | 204,082,387 |
| IV..... | 125,464,644 | 69,513,846 | 53,252,326 | 62,367,557 | 136,819,200 | 199,186,757 |
| V..... | 126,737,836 | 72,702,277 | 69,485,945 | 65,066,029 | 134,176,000 | 199,242,029 |
| VI.... | 122,315,240 | 66,146,229 | 61,449,650 | 49,615,643 | 117,801,600 | 167,417,244 |
| VII.... | 137,161,129 | 71,094,381 | 60,121,331 | 44,335,004 | 108,186,000 | 152,521,003 |
| VIII... | 145,628,521 | 78,722,418 | 70,485,150 | 50,280,421 | 113,299,200 | 163,579,621 |
| IX..... | 140,089,819 | 63,460,810 | 60,264,796 | 46,701,374 | 113,568,000 | 160,269,374 |
| X..... | 145,405,453 | 84,104,734 | 47,621,342 | 63,065,587 | 107,408,000 | 170,473,587 |
| XI..... | 134,695,400 | 69,369,795 | 55,906,550 | 76,744,964 | 103,801,600 | 180,546,564 |
| XII.... | 143,354,042 | 58,491,723 | 65,713,796 | 86,164,059 | 96,947,200 | 183,111,259 |
| Year, 1912 | 1,581,920,287 | 819,665,948 | 746,396,452 | ..... | ..... | ..... |
| I, 1913. | ..... | ..... | ..... | 105,312,582 | 96,857,600 | 202,170,182 |

# IRON TRADE REVIEW

**NEW YORK—Jan. 22**

The iron and steel trades are still inclined to be rather quiet as far as new business is concerned. Specifications on contracts are liberal, however, and there is no cessation in the activity of mills. The pressure for deliveries continues.

The general conditions remain good and the promise for future business seems excellent. New orders are slow largely because consumers are well covered for some time and are not yet ready for further commitments.

In pig-iron trade is a little slower and furnaces are not as stiff on prices as they were. This is especially the case in the South, and concessions of 50c. per ton are said to have been made, to secure orders.

**PITTSBURGH—Jan. 21**

Trade developments have not been striking in the past week. The finished steel market continues exceptionally strong, with heavy pressure for deliveries, perhaps heavier than 30 days ago, and a larger volume of specifying than would perhaps be expected, considering that many low-priced contracts expired Dec. 31, and live contracts now represent a materially higher price average. In sheets and tinplates the specifications are very heavy, running well ahead of current production. New contracting all along the line is relatively light, but this is entirely seasonable.

**Pig Iron**—A remarkable incident is the offering of Cleveland foundry iron in the Pittsburgh market, for the first time on record. One of the Cleveland producers has quietly offered No. 2 foundry iron, to be made in Cleveland, at $17.90, delivered Pitsburgh, which is 50c. below the Valley parity, since Valley iron has lately been quoted at a minimum of $17.50 at furnace, or $18.40 delivered Pitsburgh. The Cleveland iron, at the delivered price quoted, would net only $16.50 at furnace, whereas the Cleveland market has been quoted for several weeks at $17.75, delivered Cleveland, which is equal to $17.50 at Cleveland furnaces, there being a uniform switching charge of 25c. Pig-iron freights to Pittsburgh are 90c. from the Valleys and $1.40 from Cleveland. None of the iron offered has been taken, Pitsburgh consumers being practically out of the market. On the basis of relative freight rates, Cleveland furnaces can assemble coke and ore together at a net cost of 79c. less than Valley furnaces, so that they could stand their 50c. disadvantage on pig iron to Pittsburgh and still be 29c. aheal. A lot of 15,000 tons of foundry iron has been lying at Dunbar, Penn., for a long time, being subject to litigation. This has now been cleared to such an extent that the iron is being offered, at $17.50, Dunbar, equal to $18.35, delivered Pittsburgh. Bessemer is scarce, and the Jones & Laughlin Steel Co., in buying some 25,000 or 30,000 tons for delivery over the next few weeks, could not shade $17.25, Valley, but had to pay $17.35 on a small portion of the tonnage. The last authenticated sale of basic was at $16.50, Valley, though in some quarters it is believed the price could be shaded fractionally. We quote: Bessemer, $17.25@17.50; basic, $16.50; malleable, $17@17.50; No. 2 foundry, $17.50; forge, $17, all at Valley furnaces, 90c. higher delivered Pittsburgh.

**Ferromanganese**—The prompt market continues easy, at about the contract price. There is little doing in contracts. We quote prompt at $65@70, and contract at $65, Baltimore.

**Steel**—Both consumers and producers continue to sound the market for steel, billets and sheet bars, but only rarely is any steel found. The famine continues and there is no definite indication as to when it will be broken. It is believed that from $29 to $30, maker's mill, Pittsburgh or Youngstown, could readily be obtained for either billets or sheet bars were they available for any early delivery. No quotations are made for late delivery. Rods continue firm at $30, Pittsburgh.

**Sheets**—The advance in sheets of $2 a ton made by the leading interest effective Jan. 13 was immediately followed by the relatively few independents who had not already advanced prices. There has been a moderate amount of contracting, but not a great deal, as the mills are reserved about selling. Specifications on contracts are excellent with the mills which have contracts, some of them having refrained from contracting, either because they did not have steel bought, or because they expected to sell their product on the prompt market at premium prices. We quote: Blue annealed, 10 gage, 1.75@1.80c.; black, 28 gage, 2.35@2.40c.; galvanized, 28 gage, 3.50@3.60c.; painted corrugated, 2.55c.; galvanized corrugated, 3.55c. per pound.

**IRON ORE TRADE**

**Eastern Iron Ores** are being offered to furnaces in Eastern Pennsylvania at 7¾@8c. per unit delivered.

Charles M. Schwab, for the Bethlehem Iron Co., has secured control of the Tofo iron deposit near Coquimbo in Chile. This deposit is credited, on a preliminary examination, with 100,000,000 tons of ore, running 60 to 67 per cent. iron and very low in phosphorus. The Bethlehem-Chile Iron Co. has been organized to open mines. The ore will be shipped through the Panama Canal.

**British Iron Ore Imports** year ended Dec. 31 were 6,343,599 tons in 1911, and 6,602,473 in 1912; increase, 258,874 tons. Imports of manganese ores for the year were 358,915 tons in 1911, and 387,578 in 1912; increase, 28,663 tons.

# COAL TRADE REVIEW

**NEW YORK—Jan. 22**

The coal markets show very little change from last week. Transportation conditions in the West are generally good, and coal is moving freely. In the Seaboard market coal supplies are fair, but prices hold firm.

Anthracite companies are still rushed to meet current demand. The call for domestic sizes has been stimulated by a sharp cold spell in the East.

**Anthracite Coal Shipments** in December were 5,944,502 long tons. For the year ended Dec. 31 they were 69,954,299 tons in 1911, and 63,610,578 tons in 1912, a decrease of 6,343,721 tons. Only about one-half of the shortage caused by the April-May stoppage was made up in the following months.

**Foreign Coal Trade**—Exports and imports of fuel in the United States 11 months ended Nov. 30, long tons:

| | Exports | Imports | Excess |
|---|---|---|---|
| Anthracite | 3,404,958 | 1,670 | Exp. 3,403,288 |
| Bituminous | 13,549,753 | 1,480,503 | Exp. 12,069,250 |
| Bunker coal | 6,766,443 | ..... | Exp. 6,766,443 |
| Coke | 735,059 | 95,732 | Exp. 639,327 |
| Total | 24,456,213 | 1,577,905 | Exp. 22,878,308 |
| Total, 1911 | 23,155,637 | 1,167,125 | Exp. 21,988,512 |

The bunker coal, or coal furnished to steamships in foreign trade, is practically all bituminous.

# CHEMICALS

**NEW YORK—Jan. 22**

The general market is steady and fairly active, with demand reported for heavy chemicals.

**Arsenic**—The market is extremely quiet. Consumers seem to be well supplied and there is nothing doing. Prices are nominally unchanged at $4.50@4.75 per 100 lb. for both spot and futures.

**Copper Sulphate**—The market is steady with fair business. Prices are unchanged at $5.50 per 100 lb. for carload lots and $5.75 for smaller parcels.

**Nitrate of Soda**—Business has started up briskly and sales are reported of 21,000 tons here for January-March arrivals. Quotations are stronger at 2.60c. per lb. for spot and February; 2.57½c. for March and April; 2.55c. for May and June; 2.50c. for later deliveries.

Messrs. W. Montgomery & Co., London, estimate the production of nitrate in Chile in 1912 at 2,540,000 long tons, an increase of 58,000 tons over 1911. The consumption for three years is estimated as follows, in long tons:

| | 1910 | 1911 | 1912 |
|---|---|---|---|
| Continent of Europe | 1,531,000 | 1,564,000 | 1,778,000 |
| United Kingdom | 120,000 | 132,000 | 130,000 |
| United States | 501,000 | 556,000 | 481,000 |
| Other countries | 89,000 | 103,000 | 115,000 |
| Total | 2,241,000 | 2,355,000 | 2,504,000 |

The United States showed in 1912 a decrease of 76,000 tons from 1911, and from 1910 a decrease of 20,000 tons.

**Potash Salts**—A Berlin dispatch of Jan. 16 says: "The German Government is preparing a new potash bill which is designed to restrict production, according to a statement made by Clemens Delbrueck, minister of the interior, at the meeting of the budget committee of the Imperial Parliament. The measure will probably be brought in before the termination of the present session."

### Assessments

| Company | Delinq | Sale | Amt. |
|---|---|---|---|
| Andes, Nev. | Feb. 4 | Feb. 25 | $0.03 |
| Belcher, Nev. | Feb. 7 | Feb. 28 | 0.10 |
| Big Elk, Ida. | Dec. 31 | Jan. 30 | 0.002 |
| Butte & Anaconda, Mont. | Jan. 1 | Feb. 1 | 0.0½ |
| Confidence, Nev. | Feb. 7 | Feb. 26 | 0.20 |
| Consolidated Imperial, Nev. | Jan. 8 | Jan. 29 | 0.01 |
| Copper Hill, Ida. | Jan. 5 | Feb. 5 | 0.002 |
| Dry Cañon Con., Utah | Jan. 14 | Feb. 12 | 0.001 |
| High Grade, Mont. | Jan. 18 | Feb. 18 | 0.0½ |
| Imperial, Calif. | Jan. 7 | Jan. 28 | 0.003½ |
| North Bunker Hill, Ida. | Jan. 1 | Feb. 1 | 0.002 |
| North Star, Nev. | Jan. 13 | ..... | 0.02 |
| O.K. Silver M. & M. Co., Utah | Jan. 30 | Feb. 20 | 0.0½ |
| Ophir, Nev. | Jan. 23 | Feb. 14 | 0.15 |
| Royal, Ida | Dec. 16 | Jan. 26 | 0.00½ |
| Seg. Belcher & Midas, Nev. | Jan. 7 | Jan. 31 | 0.02 |
| Sierra Nevada, Nev. | Jan. 30 | Feb. 20 | 0.10 |
| Superior & Boston, Mont. | Jan. 4 | ..... | 1.00 |
| Tarbox, Ida. | Nov. 19 | Jan. 28 | 0.002 |
| Union Consolidated, Nev. | Jan. 8 | Jan. 30 | 0.15 |
| Utah United, Utah. | Jan. 9 | Jan. 30 | 0.15 |
| Verde, Utah. | Jan. 1 | Feb. 1 | 0.001 |
| Vienna, Ida. | Jan. 2 | Feb. 1 | 0.00½ |
| Wabash, Utah. | Jan. 24 | Feb. 15 | 0.05 |

### Monthly Average Prices of Metals

SILVER

| Month | New York | | | London | | |
|---|---|---|---|---|---|---|
| | 1910 | 1911 | 1912 | 1910 | 1911 | 1912 |
| January | 52.375 | 53.795 | 56.260 | 24.154 | 24.865 | 25.887 |
| February | 51.534 | 52.222 | 59.043 | 23.794 | 24.081 | 27.190 |
| March | 51.454 | 52.745 | 58.375 | 23.690 | 24.324 | 26.875 |
| April | 53.221 | 53.325 | 59.207 | 24.483 | 24.595 | 27.284 |
| May | 53.870 | 53.308 | 60.880 | 24.797 | 24.583 | 28.038 |
| June | 53.462 | 53.043 | 61.290 | 24.651 | 24.486 | 28.215 |
| July | 54.150 | 52.630 | 60.654 | 25.034 | 24.286 | 27.919 |
| August | 52.912 | 52.171 | 61.606 | 24.428 | 24.082 | 28.375 |
| September | 53.295 | 52.440 | 63.078 | 24.567 | 24.209 | 29.088 |
| October | 55.490 | 53.340 | 63.471 | 25.596 | 24.594 | 29.299 |
| November | 55.635 | 55.719 | 62.792 | 25.680 | 25.649 | 29.012 |
| December | 54.428 | 54.905 | 63.365 | 25.160 | 25.349 | 29.320 |
| Year | 53.486 | 53.304 | 60.835 | 24.670 | 24.592 | 28.042 |

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

| Month | New York | | | | London, Standard | |
|---|---|---|---|---|---|---|
| | Electrolytic | | Lake | | | |
| | 1911 | 1912 | 1911 | 1912 | 1911 | 1912 |
| January | 12.295 | 14.094 | 12.680 | 14.337 | 55.600 | 62.760 |
| February | 12.256 | 14.084 | 12.611 | 14.329 | 54.974 | 62.893 |
| March | 12.139 | 14.698 | 12.447 | 14.868 | 54.704 | 65.884 |
| April | 12.019 | 15.741 | 12.275 | 15.930 | 54.034 | 70.294 |
| May | 11.989 | 16.031 | 12.214 | 16.245 | 54.313 | 72.352 |
| June | 12.385 | 17.234 | 12.611 | 17.443 | 56.365 | 78.259 |
| July | 12.463 | 17.190 | 12.720 | 17.353 | 56.673 | 76.686 |
| August | 12.405 | 17.498 | 12.634 | 17.644 | 56.266 | 78.670 |
| September | 12.201 | 17.508 | 12.508 | 17.698 | 55.253 | 78.762 |
| October | 12.189 | 17.314 | 12.370 | 17.661 | 55.170 | 76.389 |
| November | 12.616 | 17.326 | 12.769 | 17.617 | 57.253 | 76.890 |
| December | 13.552 | 17.376 | 13.768 | 17.600 | 62.068 | 75.516 |
| Year | 12.376 | 16.341 | 12.634 | 16.560 | 55.973 | 72.942 |

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN

| Month | New York | | London | |
|---|---|---|---|---|
| | 1911 | 1912 | 1911 | 1912 |
| January | 41.255 | 42.529 | 186.896 | 191.519 |
| February | 41.614 | 42.962 | 189.642 | 195.036 |
| March | 40.157 | 42.577 | 182.617 | 192.619 |
| April | 42.185 | 43.923 | 193.042 | 200.513 |
| May | 43.115 | 46.053 | 197.767 | 208.830 |
| June | 44.605 | 45.815 | 207.388 | 205.863 |
| July | 42.406 | 44.519 | 193.100 | 202.446 |
| August | 43.319 | 45.857 | 190.479 | 208.351 |
| September | 39.755 | 49.135 | 180.846 | 223.762 |
| October | 41.185 | 50.077 | 187.138 | 227.353 |
| November | 43.125 | 49.891 | 194.967 | 226.619 |
| December | 44.655 | 49.815 | 203.358 | 226.875 |
| Av. Year | 42.281 | 46.096 | 192.353 | 209.322 |

New York in cents per pound; London in pounds sterling per long ton.

LEAD

| Month | New York | | St. Louis | | London | |
|---|---|---|---|---|---|---|
| | 1911 | 1912 | 1911 | 1912 | 1911 | 1912 |
| January | 4.483 | 4.435 | 4.334 | 4.327 | 13.009 | 15.597 |
| February | 4.440 | 4.026 | 4.266 | 3.946 | 13.043 | 15.738 |
| March | 4.394 | 4.073 | 4.238 | 4.046 | 13.122 | 15.997 |
| April | 4.412 | 4.200 | 4.262 | 4.118 | 12.889 | 16.331 |
| May | 4.373 | 4.194 | 4.223 | 4.072 | 12.984 | 16.509 |
| June | 4.435 | 4.392 | 4.292 | 4.321 | 13.260 | 17.588 |
| July | 4.499 | 4.720 | 4.397 | 4.603 | 13.530 | 18.544 |
| August | 4.500 | 4.569 | 4.406 | 4.452 | 14.260 | 19.655 |
| September | 4.485 | 5.048 | 4.356 | 4.924 | 14.744 | 22.292 |
| October | 4.265 | 5.071 | 4.139 | 4.894 | 15.332 | 20.630 |
| November | 4.298 | 4.615 | 4.181 | 4.463 | 15.821 | 18.193 |
| December | 4.450 | 4.303 | 4.332 | 4.152 | 15.648 | 18.069 |
| Year | 4.420 | 4.471 | 4.286 | 4.360 | 13.970 | 17.929 |

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

SPELTER

| Month | New York | | St. Louis | | London | |
|---|---|---|---|---|---|---|
| | 1911 | 1912 | 1911 | 1912 | 1911 | 1912 |
| January | 5.452 | 6.442 | 5.302 | 6.292 | 23.887 | 26.642 |
| February | 5.518 | 6.499 | 5.368 | 6.349 | 23.276 | 26.661 |
| March | 5.563 | 6.626 | 5.413 | 6.476 | 23.016 | 26.048 |
| April | 5.399 | 6.633 | 5.249 | 6.483 | 23.743 | 25.644 |
| May | 5.348 | 6.679 | 5.198 | 6.529 | 24.375 | 25.790 |
| June | 5.520 | 6.877 | 5.370 | 6.727 | 24.612 | 25.763 |
| July | 5.695 | 7.116 | 5.545 | 6.966 | 25.006 | 26.174 |
| August | 5.953 | 7.028 | 5.803 | 6.878 | 26.801 | 26.443 |
| September | 5.869 | 7.454 | 5.719 | 7.313 | 27.750 | 27.048 |
| October | 6.102 | 7.426 | 5.951 | 7.276 | 27.256 | 27.543 |
| November | 6.380 | 7.371 | 6.223 | 7.221 | 26.795 | 26.804 |
| December | 6.301 | 7.162 | 6.151 | 7.081 | 26.849 | 26.494 |
| Year | 5.758 | 6.943 | 5.608 | 6.799 | 25.281 | 26.421 |

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

PIG IRON AT PITTSBURG

| Month | Bessemer | | Basic | | No. 2 Foundry | |
|---|---|---|---|---|---|---|
| | 1911 | 1912 | 1911 | 1912 | 1911 | 1912 |
| January | $15.90 | $15.12 | $14.40 | $13.32 | $14.75 | $14.00 |
| February | 15.90 | 15.03 | 14.50 | 13.28 | 14.81 | 14.01 |
| March | 15.90 | 14.95 | 14.65 | 13.66 | 14.96 | 14.10 |
| April | 15.90 | 15.13 | 14.65 | 13.90 | 15.00 | 14.15 |
| May | 15.90 | 15.14 | 14.30 | 13.90 | 14.72 | 14.12 |
| June | 15.90 | 15.15 | 14.06 | 14.11 | 14.56 | 14.22 |
| July | 15.90 | 15.15 | 14.03 | 14.38 | 14.53 | 14.38 |
| August | 15.90 | 15.43 | 14.00 | 14.90 | 14.47 | 14.85 |
| September | 15.90 | 16.86 | 13.57 | 16.03 | 14.40 | 15.63 |
| October | 15.43 | 17.90 | 13.44 | 17.18 | 14.34 | 17.22 |
| November | 14.92 | 18.07 | 13.30 | 17.09 | 14.25 | 18.00 |
| December | 15.15 | 18.15 | 13.10 | 17.45 | 13.90 | 18.73 |
| Year | $15.72 | $16.01 | $13.94 | $14.93 | $14.49 | $15.28 |

## STOCK QUOTATIONS

COLO. SPRINGS Jan. 21

| Name of Comp. | Bid. |
|---|---|
| Acacia | .03⅞ |
| Cripple Cr'k Con. | .01⅜ |
| C. K. & N. | .16 |
| Doctor Jack Pot | .05½ |
| Elkton Con. | .67½ |
| El Paso | 5.95 |
| Findlay | .05 |
| Gold Dollar | .14½ |
| Gold Sovereign | .02½ |
| Isabella | .13½ |
| Jack Pot | .05½ |
| Jennie Sample | .05 |
| Lexington | .004 |
| Moon Anchor | .01 |
| Old Gold | .03 |
| Mary McKinney | .58 |
| Pharmacist | .01½ |
| Portland | .96 |
| Vindicator | 86 |
| Work | .004 |

SALT LAKE Jan. 21

| Name of Comp. | Bid. |
|---|---|
| Beck Tunnel | .08 |
| Black Jack | .10 |
| Cedar Talisman | .01¼ |
| Colorado Mining | .18½ |
| Columbus Con. | .10 |
| Crown Point | .03¼ |
| Daly-Judge | 6.25 |
| Grand Central | .74 |
| Iron Blossom | 1.25 |
| Little Bell | $.10 |
| Lower Mammoth | .04½ |
| Mason Valley | $7.50 |
| May Day | .22½ |
| Nevada Hills | $1.52½ |
| New York | $ 00¾ |
| Prince Con | 1.00 |
| Silver King Coal'n | 2.75 |
| Sioux Con. | .02½ |
| Uncle Sam | .11 |
| Yankee | .15 |

TORONTO Jan. 18

| Name of Comp. | Bid | Name of Comp. | Bid |
|---|---|---|---|
| Bailey | .09 | Foley O'Brien | .13 |
| Coniagas | 8.40 | Hollinger | 15.25 |
| T. & Hudson Bay | 63.00 | Imperial | .02 |
| Timiskaming | .31 | Jupiter | .36 |
| Wettlaufer-Lor | .15 | Pearl Lake | .29 |
| Apex | .01 | Porcu. Gold | .18 |
| Crown Chartered | .01 | Preston E. D | .03 |
| Dobie | .25 | Rea | .25 |
| Dome | 19.00 | Swastika | .09 |
| Dome Exten | .06 | West Dome | .10 |

SAN FRANCISCO Jan. 21

| Name of Comp. | Clg. | Name of Comp. | Bid |
|---|---|---|---|
| COMSTOCK STOCKS | | MISC. NEV. & CAL. | |
| Alta | .04 | Belmont | 8.00 |
| Belcher | .18 | Jim Butler | .70 |
| Best & Belcher | .03 | MacNamara | .22 |
| Caledonia | .73 | Midway | .34 |
| Challenge Con | .04 | Mont.-Tonopah | 1.75 |
| Chollar | .02 | North Star | .20 |
| Confidence | .17 | West End Con | 1.45 |
| Con. Virginia | .14 | Atlanta | .17 |
| Crown Point | .22 | Booth | .02 |
| Gould & Curry | .01 | C.O.D. Con | .08 |
| Hale & Norcross | .07 | Comb. Frac | .07 |
| Mexican | .86 | Jumbo Extension | .35 |
| Occidental | .70 | Pitts.-Silver Peak | .66 |
| Ophir | .10 | Silver Pick | .05 |
| Overman | .22 | St. Ives | .30 |
| Potosi | .02 | Tramp Con | .01 |
| Savage | .03 | Argonaut | ‡1.75 |
| Sierra Nevada | .13 | Bunker Hill | ‡4.50 |
| Union Con. | .17 | Central Eureka | .30 |
| Yellow Jacket | .18 | So. Eureka | 3.00 |

N. Y. EXCH. Jan. 21

| Name of Comp. | Clg. |
|---|---|
| Amalgamated | 73⅜ |
| Am. Agri. Chem | 52 |
| Am.Sm.&Ref.,com | 72¼ |
| Am. Sm. & Ref., pf. | 105⅛ |
| Am. Sm. Sec., pf. B | 85¼ |
| Anaconda | 37¾ |
| Batopilas Min | 1 |
| BethlehemSteelpf | 68 |
| Chino | 43¼ |
| Federal M. & S., pf. | 39 |
| Goldfield Con | 2 |
| GreatNor.,ore,,ctf. | 38½ |
| Guggen. Exp | 48 |
| Homestake | 115 |
| Inspiration Con. | 16½ |
| Miami Copper | 24 |
| Nat'nalLead,com. | 48¾ |
| National Lead, pf. | 105 |
| Nev. Consol. | 18¼ |
| Phelps Dodge | 210 |
| Pittsburg Coal, pf. | 89 |
| Ray Con | 19⅛ |
| RepublicI&S,com. | 23¾ |
| Republic I & S, pf. | 82⅛ |
| SlossSheffi'd,com. | 40 |
| Sloss Sheffield, pf. | 93½ |
| Tennessee Copper | 34⅜ |
| Utah Copper | 54⅞ |
| U. S. Steel, com | 64¼ |
| U. S. Steel, pf. | 109⅞ |
| Va.Car. Chem., pf. | 109 |

N. Y. CURB Jan. 21

| Name of Comp. | Clg. |
|---|---|
| Barnes King | ‡ 86 |
| Beaver Con | .43 |
| Braden Copper | 9⅛ |
| B. C. Copper | 4¼ |
| Buffalo Mines | 1⅞ |
| Caledonia | ‡ 40 |
| Con. Ariz. Sm. | ⅞ |
| Davis-Daly | 1⅝ |
| Diam'field-Daisy | 4⅛ |
| Ely Con | .12 |
| Florence | .42 |
| Giroux | 3⅜ |
| Gold Hill Con. | ⅛ |
| Greene Cananea | 8½ |
| Greenwater | .05 |
| Internat. S. & R. | ‡124 |
| Kerr Lake | 2⅜ |
| Keystone | ‡2 |
| La Rose | 2⅝ |
| McKinley-Dar-Sa. | 2 |
| Min. Co. of A. new | 3 |
| Motherlode Gold | ‡.60 |
| Nev. Utah M. & S. | ‡ 02 |
| Nipissing Mines | 8¾ |
| Ohio Copper | 1 |
| Pacific Sm. & M. | ⅛ |
| Puebla S. & R. | 2⅞ |
| South Live Oak | ‡2 |
| South Utah M. & S. | ⅜ |
| Standard Oil (Old) | 1160 |
| Stand'd Oil of N.J. | 431 |
| Stewart | 1⅞ |
| Tonopah | 5⅛ |
| Tonopah Ex | 2 |
| Tonopah Merger | .89 |
| Tri-Bullion | ⅛ |
| Tularosa | ⅜ |
| Union Mines | ‡1⅞ |
| United Cop., pfd. | 6 |
| Yukon Gold | 3 |

LONDON Jan. 22

| Name of Com. | Clg. |
|---|---|
| Camp Bird | £1 2s 6d |
| El Oro | 0 17 0 |
| Esperanza | 1 16 9 |
| Mexico Mines | 6 12 6 |
| Oriental Con. | 1 10 9 |
| Oroville | 0 7 0 |
| Santa Gert'dis | 1 7 3 |
| Tomboy | 1 7 6 |

BOSTON EXCH. Jan. 21

| Name of Comp. | Clg. |
|---|---|
| Adventure | 4¼ |
| Ahmeek | 310 |
| Algomah | 1⅛ |
| Allouez | 37 |
| Am. Zinc | 28 |
| Ariz. Com., ctfs. | 3½ |
| Bonanza | .31 |
| Boston & Corbin | 5½ |
| Butte & Balak | 3 |
| Calumet & Ariz | 66 |
| Calumet & Hecla | 500 |
| Centennial | 16 |
| Cliff | 3 |
| Copper Range | 48 |
| Daly West | 3½ |
| East Butte | 13½ |
| Franklin | 7⅜ |
| Granby | 68¾ |
| Hancock | 20 |
| Hedley Gold | 28 |
| Helvetia | ‡3¾ |
| Indiana | 15 |
| Island Cr'k, com | 55 |
| Island Cr'k, pfd. | 84 |
| Isle Royale | 28¾ |
| Keweenaw | 2⅜ |
| Lake | 20¾ |
| La Salle | 4⅝ |
| Mass | 5 |
| Michigan | 1⅜ |
| Mohawk | 54¼ |
| New Arcadian | 2⅛ |
| New Idria Quick. | ‡6½ |
| North Butte | 30¾ |
| North Lake | 2¾ |
| Ojibway | 2¼ |
| Old Dominion | 49 |
| Osceola | 97 |
| Quincy | 73 |
| Shannon | 11¾ |
| Shattuck-Ariz. | 26 |
| Superior | 32½ |
| Superior & Bost. | 2½ |
| Tamarack | 31 |
| Trinity | 4⅞ |
| Tuolumne | 3½ |
| U. S. Smelting | 41 |
| U. S. Smelt'g, pf. | 49¼ |
| Utah Apex | 1¾ |
| Utah Con | 10 |
| Victoria | 2 |
| Winona | 3½ |
| Wolverine | 67½ |
| Wyandot | 1¼ |

BOSTON CURB Jan. 21

| Name of Comp. | Last |
|---|---|
| Alaska Gold M. | 14 |
| Bingham Mines | 4 |
| Boston Ely | .90 |
| Boswyocolo | ‡.01 |
| Butte Central | 7⅛ |
| Cactus | 06 |
| Calaveras | 3 |
| Chief Cons | 1½ |
| Corbin | .17 |
| Cortez | .45 |
| Crown Reserve | 3½ |
| First Nat. Cop. | 2½ |
| Majestic | .43 |
| Mexican Metals | 2 |
| Moneta Porc. | ‡.03 |
| Nevada-Douglas | ‡2½ |
| New Baltic | ½ |
| Oneco | 1½ |
| Raven Copper | .24 |
| Rhode Island Coal | .05 |
| San Antonio | ‡3½ |
| Smokey Dev. | 2½ |
| S. W. Miami | 3½ |
| South Lake | 5½ |
| Tretheway | .31 |
| United Verde Ext. | .66 |

‡Last quotation.